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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G06F 17/60 — A2

(11) International Publication Number: WO 00/68856

(43) International Publication Date: 16 November 2000 (16.11.00)

(21) International Application Number: PCT/US00/12905

(22) International Filing Date: 10 May 2000 (10.05.00)

(30) Priority Data:
60/133,646 11 May 1999 (11.05.99) US

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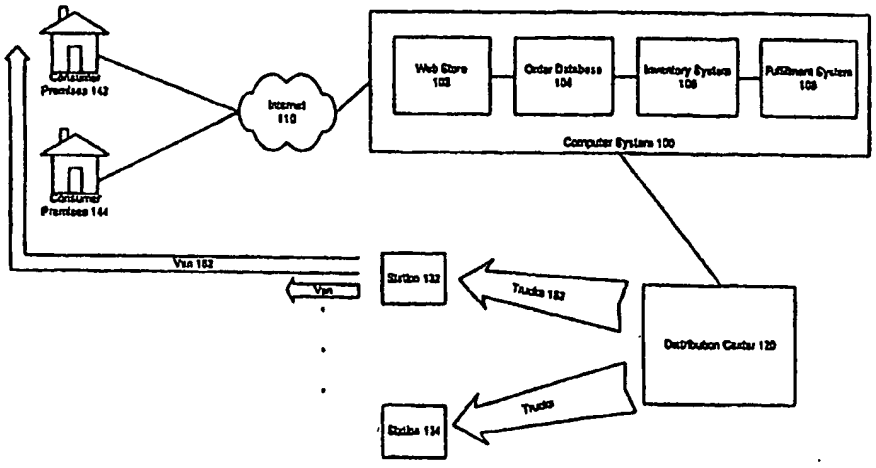
(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: ELECTRONIC COMMERCE ENABLED DELIVERY SYSTEM AND METHOD



(57) Abstract

A system for distributing groceries to customers' homes is described. As part of the system, a distribution center stores the groceries. A delivery system, having a number of vehicles, delivers the groceries from the distribution center to the customers' homes. A computer system coordinates the distribution center and the delivery system so that, during normal operation of the system, customers can reserve delivery time windows on the same day orders are received by the computer system. Additionally, the computer guarantees the groceries ordered by the customers will arrive at their homes during the reserved delivery time windows. The computer can make this guarantee using inventory information about the groceries in the distribution center. Additionally, the computer can use information about available distribution resources, and information about available delivery resources.

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ELECTRONIC COMMERCE ENABLED DELIVERY SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to the field of electronic commerce. In particular, the invention relates to a system and method for delivering goods, such as groceries, using electronic commerce.

Description of the Related Art

Companies have been delivering goods to customer's homes for years using many different kinds of delivery systems. Examples run from horse and carriage home delivery of milk to concierge ordering and delivery like that provided by Peapod, Inc. Importantly, consumers continue to express a desire for home delivery of goods. However, many of the previous systems have significant limitations that prevent their adoption on a large scale.

For example, the concierge like service provided by Peapod, Inc. allows customers to access a computer database at Peapod and place grocery orders. "Shoppers" (employees of Peapod) fill the orders by traveling to grocery stores and purchasing the groceries. The groceries are then delivered to the customer's home. Clearly, Peapod has difficulty offering goods to customers for less than those goods were purchased at the grocery stores. To have a viable business, Peapod adds delivery charges onto the grocery bill. This makes the groceries more expensive than if the customer had gone and bought them at the grocery store himself/herself.

Additionally, when a customer places an order, the customer does not know if the ordered good is actually in stock. Clearly, if the grocery store does not have the

ordered item, the shopper cannot deliver that item. However, when a customer visits a grocery store, the customer can see that an item is out of stock and pick some other item to replace it.

Delivery scheduling problems arise with services like Peapod. For example, scheduling deliveries for the same day the order is placed can be very difficult to coordinate. Therefore, many shopping services do not offer this feature. Additionally, completing an order may take a considerable amount of time; so long, that the customer may lose an otherwise available delivery time.

Therefore, it is desirable to provide a delivery system that can delivery groceries and/or other goods, to customers' homes, at a reasonable cost, guaranteeing the availability of a item, and providing guaranteed deliveries on the day orders are placed.

SUMMARY OF THE INVENTION

A system for distributing groceries to customers' homes is described. As part of the system, a distribution center stores the groceries. A delivery system, having a number of vehicles, delivers the groceries from the distribution center to the customers' homes. A computer system coordinates the distribution center and the delivery system so that, during normal operation of the system, customers can reserve delivery time windows on the same day orders are received by the computer system. Additionally, the computer guarantees the groceries ordered by the customers will arrive at their homes during the reserved delivery time windows. The computer can make this guarantee using inventory information about the groceries in the distribution center. Additionally, the computer can use information about available distribution resources, and information about available delivery resources.

As one aspect of the invention, a customer can access the computer system through a computer interface, such as the Internet. When the customer selects a delivery window, the computer system reserves distribution resources in the distribution center and delivery resources in the delivery system. This ensures that a customer will be able to place an order and have that order delivered to the customer's home within the scheduled delivery window.

The computer system displays only items that are available for delivery to customers. This is done by tracking the inventory in the distribution center, including which items have already been ordered but not yet delivered. Thus, customers will only be able to order items that can be delivered.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 illustrates an example system for delivering goods.

Figure 2 illustrates a detailed view of the subsystems of the system of Figure 1.

Figure 3 is a summary of the shopping flow for the electronic commerce site.

Figure 4 shows a layout of a portion of a distribution center according to one embodiment of the invention.

DETAILED DESCRIPTION

A. Definitions

The following definitions are provided to aid in the understanding of various embodiments of the invention. Following the definitions are overview and then detailed descriptions of various embodiments of the invention.

1. Product

A product, also called a good or item, is something for sale. In some embodiments, the products for sale include a number of grocery items typically found in a large grocery store including: foods, fresh fruits and vegetables, frozen items, cold items, meats, bakery goods, dairy products, prepared meals, magazines, book, compact discs, health and beauty items, prescription and over the counter drugs, office supplies, pet food, and/or other items found at a grocery store, household goods store, and/or drug store. Other types of consumer products can also be distributed through the system.

a) Fill to Order

Some goods are fill to order, e.g. prepared at the time an order is placed. For example, deli department, meat department, fruit and vegetable products, and prepared meals can be filled to order. In each case, based on the order, the requisite product is prepared and packaged. For example, if Mrs. Smith orders strawberries, the requested amount will be selected and packaged upon her order. The process is the same for other fill to order items. In some embodiments, specialized packaging is used for the fill to order goods The specialized packaging can include the consumer's name on a label placed on the fill to order goods.

b) Pricing and Units of Measure

Products are priced by a particular unit of measure. One measure is by "each" or by stock keeping unit (SKU), e.g. per 16 oz bag of Brand X potato chips or per pint of strawberries. Another unit of measure is by weight, e.g. price per pound.

c) Information Associated with Products

Each product is associated with a stock keeping unit (SKU). For each SKU, information is kept about the item including: packaging dimension, volume, weight, temperature type, restricted product, perishability, unit of measure, chill chain (see below for a definition of chill chain) requirements, and/or nutritional information, etc.

The temperature type can be one of the primary temperature zones (ambient, refrigerated, or frozen), or a subzone for specialty items like flowers, cigars, wines, and chocolates.

Restricted products like alcohol and tobacco can receive specialized handling based on local laws and to require age verification at delivery.

The packaging dimensions and weight can be used to plan packing of totes and trays. In some embodiments, the weight can also be used to verify correct packing as trays and totes move through the conveyors. For example, if five SKUs of a 15 oz bag of potato chip are scanned into a tray, and that tray enters the system weighing less than five times the product weight of the five bags together with the tray, an exception can be noted and/or the tray or tote can be rechecked.

The perishability information can be used to ensure that products are removed before their expiration.

The chill chain requirements can be used to ensure that products are maintained at the appropriate temperatures and that any necessary records are maintained.

2. Order

An order is comprised of multiple products. A single order may have multiple delivery times. For example, an order that includes products that are not currently in stock will be divided into two or more delivery times. For example, if the consumer orders a number of groceries and a wine that is out stock, the consumer will have the option to schedule a separate delivery time for the wine. The order is displayed as a shopping cart to the consumer at the electronic commerce site. In some embodiments, each item in the order can be paid for using different payment methods and/or each item in the order can have separate delivery arrangements.

3. Consumer

A consumer, or customer, is a person or business who purchases products. In some embodiments, this purchase is made through an electronic commerce site. In some embodiments, the electronic commerce site can be accessed using a web browser. The consumer purchases products by placing an order using the electronic commerce site.

4. Database

A database typically includes one or more structured sets of data, usually associated with software to update and query the data. A simple database might be a single file containing many records, each of which contains the same set of fields where each field is a certain fixed width. Several databases may be used and maintained by embodiments of the invention.

5. Internet

An internet is any set of interconnected networks, the Internet being the largest example. More generally a mixture of internets, intranets, and extranets can be

employed by embodiments of the invention. The term Internet is used to refer to any network communication system used by embodiments of the invention to provide an electronic commerce site.

6. Chill Chain

The chill chain is the maintenance and recording of the appropriate temperatures for temperature sensitive products. This includes tracking the temperature of the product at various control points. For example, the chill chain for milk might require that the product be maintained below 40°F at all times but no less than 32°F. Chill chain control requires that the temperature of the milk be measured at critical points, and that it remain in compliance with the limits. The temperatures may need to be retained in order to verify compliance with chill chain regulations.

There are a number of legal requirements associated with storing and selling frozen and refrigerated foods. One such set of requirements are the hazard analysis critical control point (HAACP) requirements. Because products are tracked at all times and kept in temperature controlled environments, the chill chain can be assured according to HAACP requirements.

The inbound areas of the distribution center can include a chilled receiving area for refrigerated and frozen products. If no separate frozen receiving area is present, frozen items can be processed for put away with priority over refrigerated items.

7. Distribution Center

The distribution center is a regional hub for the receipt and distribution of products. In a single metropolitan area, there might be more than one distribution center. Nationwide, several hundred distribution centers may be used to provide broad distribution facilities.

In some embodiments, additional super-regional distribution centers may be used to supply items. For example, specialty products might be stocked in a Connecticut super-regional distribution center for all of New England. The products would then be distributed to the distribution centers throughout New England as needed.

In some embodiments, a distribution center has the capacity for between fifty and one-hundred thousand products in inventory. Also, a distribution center may have kitchens, bakeries, deli departments, pharmacies, and other facilities to provide certain products.

Each distribution center will typically have three main temperature zones for products: ambient, refrigerated, and frozen. However, even within these three zones, there may be subzones for specialty items, e.g. for flowers, cigars, wines, and chocolates.

The goods available from particular distribution centers may vary based on purchasing habits within the area served by the distribution center. For example, a distribution center serving New York City might have a larger selection of Kosher items to accommodate Orthodox Jewish dietary laws. Further, individual distribution centers may have special facilities, e.g. a Kosher butcher. Thus, inventory is stocked and maintained at levels to suit area preferences and purchasing habits within a region. Similarly, certain varieties of Campbell's soup such as a specialty mushroom soup may be stocked in greater volume in a distribution center serving Philadelphia, but at much lower levels at other distribution centers.

8. Tray

Trays are storage containers used to hold products within the distribution center. In one embodiment, products are stored within trays inside the carousels.

There may be several different sizes of trays. For example, as Brand X potato chips, 16 oz. size, are received, they are placed into trays for movement throughout the distribution center and storage in the carousels. There may be several different tray sizes. In this example, the potato chips fit five to a tray.

Each tray has an identifier that allows the tray to be moved through the distribution center by conveyor in an automated fashion. In this manner, a tray can be moved from the receiving area into a specific location in a carousel with the system tracking the location of the tray For example, each tray can have a bar code identifier which can be scanned as it moves past various points in the system.

9. Tote

Totes are storage containers used to hold products for transportation to the consumer. There may be several different sizes of totes. Additionally, some totes may be designed for holding frozen and refrigerated goods. Like the trays, each tote has an identifier to support automated movement through the distribution center by conveyor.

The distinction between trays and totes is generally conceptual, trays stay within the distribution center, totes leave the distribution center with products for consumers. It may be the case that similar or identical containers might be used as trays and totes. In some embodiments, the trays are relatively light and have three high sided with a removable front gate, while the totes are sturdier and have closable lids Totes can have identifiers like trays.

10. Carousel

A carousel is a high capacity storage area. Due to the rotating design of the carousels, only items stored in a small section of the carousel can be easily accessed at a given time. This trade-off allows the carousels to store large numbers of items at the

expense of rapid access. In some embodiments of the invention, carousels are used to store trays containing products. In some embodiments, carousels from Diamond Phoenix, Lewiston, ME, are used. In some embodiments, software provided by Diamond Phoenix is used to control carousel rotation and audible and visual annunciators coupled to the carousels.

11. Conveyor

A conveyor is a high speed system for moving totes and trays. Conveyors transport totes and trays throughout a distribution center. The identifiers on the trays and totes allows them to be automatically routed to specific destinations within the distribution center. In some embodiments, conveyors from Buschmann Company, Cincinnati, OH, are used. In some embodiments, conveyor movement can be automated with software from SeayCo Integrators, Conyers, GA.

12. Pod

A pod is a collection of storage areas within a distribution center. A single distribution center may have several types of pods. Each of the different pods and pod types may be adapted for different temperatures, e.g. frozen goods mechanized pod. The different pods and pod types may also be adapted for the rate of product movement, e.g. mechanized pods for fast moving items.

The naming of the pod types is based on the type of products stored in the pod rather than a particular physical or operational arrangement of the pod. For example, some embodiments of the manual pod might include a carousel. Further, any of the three pod types could be adapted for automation. In some embodiments, all of the pod types use human operators to perform pick and put tasks (described below).

a) Carousel Pods

Carousel pods, or pods, are comprised of one or more carousels adjacent to one or more conveyors. In one embodiment, each pod has three carousels adjacent to two conveyors for incoming trays and totes. In some embodiments, an additional two conveyors are provided: an express conveyor and an empty conveyor. The express conveyor is used to transport totes directly from the carousel pod to the outbound distribution point for totes. The empty conveyor is used to transport empty trays back to the receiving area to receive new incoming products.

b) Mechanized Pods

Mechanized pods, or mech pods, are areas designed to hold the faster moving, and also bulkier and heavier, products for easy access. Each mechanized pod has an inbound conveyor for totes and an outbound conveyor for totes. Received products may be placed directly into the mech pod for storing.

Totes received on the inbound conveyor will receive items from the mech pod before being placed on the outbound conveyor. Because the mech pod items may also be bulkier and heavier than other products, totes that include mech pod items may be sent to the mech pod prior to the other pods.

c) Manual Pods

Manual pods are areas where fill to order items such as produce, bulk foods, pharmacy prescriptions, and/or prepared meals may be prepared and/or stored. The products in the manual pods are typically placed in totes last. Products in manual pods are customer specific preparations, e.g. Mrs. Smith's strawberries not strawberries. Items are brought from fill to order preparation areas to the manual pods for placement (pick tasks) into totes.

For example, the ambient temperature mech pod might have bottled water, sodas, and other items. In contrast, an ambient temperature manual pod will have areas for customer specific items, e.g. Mrs. Smith's strawberries and her prepared chicken dinner.

13. Pick Task

A pick task is the retrieval of a product, or multiple quantities of the same product, to fill an order. Thus, an order for ten different products would be comprised of ten pick tasks. However, if the order included five bags of Brand X potato chips, that might be consolidated into a single pick task -- depending on the number of bags of potato chips in the pod. For example, if pod two had only two bags of potato chips left and pod three had the last three bags of potato chips, two pick tasks would be required.

a) Carousel Pick Task

Carousel pick tasks require the coordination of the conveyors to transport the tote to the appropriate pod with the carousels to bring the appropriate storage tray to an accessible position. The pick task may be scheduled, or generated, prior to the actual physical movement of the product, or products, from a carousel tray to a tote. In some cases, a pick task may be used to move products from one tray to another tray, e.g. combine trays with the same expiration date into a single tray.

Once the pick task is accomplished, the conveyor moves the tote to the next destination automatically. In some embodiments, a push button signal is employed to allow the pick operator to signal that she/he has placed the product, or products, into the tote.

b) Mechanized Pick Task

Mechanized pick tasks can be accomplished by using carts to move totes received on the inbound conveyor to the products. The products can then be put into the totes for delivery. Once the necessary items are in the totes, the tote is placed on the outbound conveyors.

c) Manual Pick Task

The process for manual pick tasks is similar to the mechanized pick task. The tote that arrives on the inbound conveyor is scanned. A list of locations with items for the tote is displayed. An operator retrieves the indicated items from the listed locations and then transfers the tote on the outbound conveyor. In some embodiments, a single operator performs all of the manual pick tasks for all orders for a particular truck.

14. Put-away Task

A put-away task, or put task, is the storage of a product in a pod. The product must be stored in a temperature appropriate pod. For example, dairy products must be stored at certain temperatures to avoid spoilage. In addition, depending on the type of product, one of the different types of pods will be selected.

a) Carousel Put-Away Task

The carousels are used to store items in trays. Once the products have been placed in trays, they can either be sent by conveyor for direct put away in the carousels or held on flow racks for later put away. The scheduling of the put away can be based on product shipments, available inventory, load, and other options.

Once the tray is received by conveyor at the carousel pod, audible and/or visual annunciators indicate the storage location for the tray. The carousel movements

are coordinated with the conveyors so that the appropriate storage area of the carousel is available when the tray is to be stored.

Weight planning can be used so that heavier trays are stored at or below waist level while lighter trays are stored at or above waist level in the carousel.

Pick and put tasks can be combined at the carousel and even interspersed with one another. In one embodiment, the carousel pod has up to sixteen totes and/or trays in any combination available for pick and put tasks at a given time.

b) Mechanized Put-Away Task

Items are stored directly into the mech pod without trays. The put away tasks can be ongoing with pick tasks. Each mech pod item has one or more fixed locations. For example, diet soda might be stored in at location A-1. Thus, when the put away operator received diet soda, she/he will scan it and be told to store it at A-1. Similarly, the pick operator will take diet soda from A-1. The locations can be arranged so that the oldest items are always taken first (first in-first out).

c) Manual Put-Away Task

Manual pods operate in a similar fashion as mech pods. However, multiple different types of items may be stored in the same location if they are part of the same order. For example, the put away task for strawberries for Mrs. Smith might go to location A-1 and similarly her prepared meal might be placed in that same location.

Items are brought from fill to order preparation areas to the manual pods for placement (pick tasks) into totes. When the tote for Mrs. Smith arrives at the manual pod for pick tasks, the identifier on the tote will be matched with the location, or locations, within the manual pod that have items for Mrs. Smith.

15. Dollies

Totes loaded with products for consumers are placed on dollies. In some embodiments, the dollies are four wheeled carts with tiered shelves.

The dollies can be transferred directly from the distribution center to trucks without lifting the totes. The dollies can also be transferred from the trucks to the vans at the stations, again without lifting the totes.

16. Truck

In some embodiments of the invention, a truck is used to transport products for consumers from the distribution center to stations. The truck could be a refrigerated truck, or some other type of vehicle. In some embodiments, a truck can carry dollies for multiple vans. In some embodiments, each truck can carry thirty-two dollies.

17. Van

In some embodiments of the invention, a van is used to transport products from the stations to the consumers. The van could be a refrigerated truck, a refrigerated van, or some other type of vehicle. In some embodiments, each van can carry four dollies.

18. Station

Each distribution center is paired with several stations, or cross-docks. For example, a distribution center for the San Francisco Bay Area might be based in Oakland. That distribution center would be paired with stations throughout the San Francisco Bay Area such as in Palo Alto, Redwood City, Berkeley, etc.

Trucks transport products for consumers from the distribution center to stations. At the stations, the dollies are transferred to vans for distribution to consumers.

19. Zone

A zone is a moderately sized geographical region served by a distribution center. Each zone has at least one station. Each zone is further divided into subzones. Each van route serves a single subzone from a station within the zone. In some embodiments, the subzones are used in delivery and route planning to improve the on time performance of deliveries. All of the zones served by a distribution center are called an area.

The following table lists the breakdown of the size of areas, zones, and subzones according to various embodiments of the invention:

Quantity (Average)	Setup 1	Setup 2	Setup 3	Setup 4	Setup 5
Zones per Distribution Center	10	20	30	40	50
Subzones per zone	10	20	5	15	20
Addresses per subzone	5,000	10,000	10,000	20,000	25,000
Addresses per zone	50,000	200,000	50,000	300,000	500,000
Addresses served by distribution center	500,000	4,000,000	2,000,000	12,000,000	25,000,000

The values in the various setups can be mixed. For example, in planning a large distribution center, setup 5 might be used, but each zone might be divided as in schedule 2, etc.

20. Distribution Resources

The distribution resources are the amount of outbound capacity at a distribution center at a given time. Because a distribution center may be receiving goods at the same time that goods are being sent out, the total capacity may not be available for outbound distribution. For example, a given distribution center might be

able to handle several thousand totes and trays within the conveyor system throughout a day, but at any given time, a fraction of that number can be moved.

For example, there might be capacity at the distribution center for five hundred twelve outbound totes for the two o'clock p.m. trucks. Thus, sixteen trucks each holding thirty-two dollies could be loaded by that time.

21. Delivery Resources

Delivery resources are the amount of delivery resources available at a given time to a given zone and/or subzone, There are two delivery resources in some embodiments of the invention: trucks and vans. Each truck route is able to support up to sixteen van routes in some embodiments of the invention. Delivery resources can be limited either by the number of trucks going to a particular station or by the number of vans delivering from a particular station. Delivery resources can be determined based on the number of planned deliveries during a particular time and the subzone of the additional delivery. If the additional delivery can be added or additional totes can be added to an order, then there are adequate delivery resources.

For example, if the Palo Alto station serves five subzones with twenty vans and two trucks on most days, then if a consumer in a subzone of the Palo Alto station wants to place an order, a schedule listing delivery times with available delivery resources displayed specific to that subzone can be shown. For example, it might show that there are no delivery resources tomorrow from noon till three o'clock p.m., but that a delivery could be scheduled between five to five thirty p.m.

If additional trucks or vans are available at a particular time, that will be reflected in the displayed schedule. Both distribution and delivery resources may be expressed in terms of a quantity of totes, e.g. delivery and/or distribution resources for four totes.

22. Mobile Field Device

A mobile field device is a portable computer for use by drivers of the vans Various embodiments can include a two way voice and/or data communication system; point of sale facilities for accepting credit card sales, credits and/or returns; a printer, a display, a bar code scanner, and/or a signature capture area.

The mobile field device can provide a number of services even if wireless communication is disrupted. Actions performed while wireless communications are disrupted are transmitted and validated once communication is again possible. This allows deliveries and other tasks to continue during communication disruptions, or outside the range of the wireless communication system.

23. Normal Operation and Exceptions

Normal operation refers to the planned operation of the system. For example, in normal operation, totes are presorted onto dollies so that each dolly has totes for a single van route. However, there may be cases where this is not possible, or there may be special circumstances called exceptions, where this is not the case. Descriptions are of the normal operation of the system unless noted.

In normal operation, items, trays and totes are correctly identified, e.g. scanned. In normal operation, items are correctly placed into the storage locations in the pods, into trays, and into totes. In normal operation, the conveyors and carousels are fully operational. For example, the distribution resources assume that the conveyor system is working fully; however, a problem in circulating trays and totes to a pod due to a conveyor problem may reduce the available distribution resources. Similarly, if the only storage location with a particular product is in a malfunctioning carousel, it may not be possible to deliver a particular item.

In normal operation, the system has resolution procedures for a number of exceptions. For example, unidentifiable trays and totes are transported to a station within the current temperature. Thus, a tray that can not be identified in a frozen pod, will be transported to a station at the appropriate frozen temperature for identification.

B. System Overview

Figure 1 illustrates an example system for delivering goods to consumers' homes. This system allows consumers to place orders using the internet and receive guarantees that an order will be delivered (by reserving delivery and distribution resources), and that the specific items ordered will be delivered in the order.

The following description includes a list of the elements of Figure 1, a description of their interconnections, and then a detailed description.

Figure 1 includes the following elements: a computer system 100, a distribution center 120, trucks 152, a number of stations 132 and 134, a van 162, the Internet 110, and two consumer premises 142 and 144. The computer system 100 includes a web store 102, an order database 104, an inventory system 106, and a fulfillment system 108. The computer system 100 is coupled to the Internet 110 and to the distribution center 120.

The interconnection between the elements is as follows. Consumers order goods through the Internet 110. The orders are received at the computer system 100 and forwarded to the distribution center 120. The computer system 100 generates all the instructions materials handling instructions in the distribution center and routing information to ensure that all the goods ordered by the consumer are delivered through the trucks 152 and vans. Specifically, from the instructions, goods for orders are placed into totes in the distribution center 120. The totes are placed on dollies that are then moved onto the trucks 152. The trucks are driven to the various stations, such

as station 132 and station 134. At the stations the dollies are moved off of the trucks 152 onto various vans, such as van 162. The vans then use the route information from the computer system 100 to make the deliveries to the consumer premises 144 and 142.

Because of the integration between the web store 102, the order database 104, the inventory system 106, and the fulfillment system 108, consumers can place orders that will be guaranteed to arrive at their premises within a scheduled delivery window, during normal operations of the system. This is a significant advantage over previous systems.

The following describes the elements of Figure 1 in greater detail. In particular, the elements of the computer system 100 will be described.

The web store 102 presents the order interface to consumers. The web store 102, as described in greater detail below, allows users to schedule delivery windows, order goods, and perform a number of related shopping tasks. The web store 102 uses the order database 104 to ensure that the goods being presented for ordering are available for delivery in the selected time windows. The web store 102 also propagates orders to the order database 104. The web store 102 can include one or more web servers that are networked with the rest of the computer system 100. Other embodiments of the system can include other web store elements such as an interface for handheld organizers such as those available from Palm Computing, Inc., a 3Com company, or Windows CE compatible handheld organizers.

The order database 104 keeps track of the status of all of the orders in the entire computer system 100. In some embodiments, some of this information is kept in the web store 102 as is described below. Importantly, other components in the computer system 100 can access the order database 104 to determine the status of an

update inventor information. Importantly, the distribution center 120 is associated with a distribution capacity (measured as an amount of distribution resources available) for processing orders in a given time frame.

The delivery system can include trucks 152, stations (e.g., 132 and 134), and vans (e.g., 162). Trucks and vans are provided with routing and delivery information to ensure that the appropriate goods reach the correct customer premises in the correct delivery window. Trucks, vans and stations, are just examples of the types of delivery system that could be used. Other embodiments of the invention can use other deliver systems (e.g, only vans without stations or trucks, mixtures of trucks and vans leaving the distribution center 120, etc.).

The customer premises 142 and 144 represent example destinations for deliveries. Destinations other than those shown can be served by the system of Figure 1. For example, business locations, apartments, condominiums, etc., could be acceptable destinations for deliveries. Any place that can be delivered to could be a destination in the system. Additionally, note that Figure 1 shows that orders are received by the computer system 100 from the customer premises. However, orders could be made from anywhere that can communicate with the computer system 100.

C. Computer System Overview

The following describes the elements of Figure 2. Figure 2 illustrates the computer system 100 in detail. The elements of Figure 2 can be used in various embodiments of the invention to ensure that goods are properly ordered and distributed.

The following lists the elements of Figure 2, describes their interconnections, and then describes the functionality of each of the elements of Figure 2.

order, place an order, update and order, etc. The order database 104 can include one or more computers running a database program such as Oracle 8, SQLServer, or databases from IBM, Informix, Sybase, etc.

The inventory system 106 keeps track of inventory in the distribution center 120. Importantly the inventory system 106 indicates to the order database 104 what items in the distribution center 120 are available to promise. That is, the inventory system 106 indicates which items in the distribution center 120 can be promised for delivery at the web store 102. If the inventory system 106 does not indicate a particular good can be ordered, then the web store 102 will not display that good. This is particularly useful because consumers will only see items that are available for purchase. The inventory system 106 also takes care of ordering goods for the distribution center 120 from distributors and manufacturers. That is, when a particular good appears to be getting low or high demand for a good occurs, the inventory system 106 can place purchase orders automatically for those goods.

The fulfillment system 108 ensures that the goods ordered are placed in their proper totes and are provided to the trucks 152 at the appropriate times. The fulfillment system 108 also interfaces with the inventory system 106 to keep the inventory system 106 up to date with respect to new items being brought into the distribution center 120.

As noted above, the distribution center 120 stores the goods for delivery to the customer premises 142 and 144. As described in greater detail below, the distribution center 120 includes a number of pods for storing goods. Automated material handling software, in the computer system 100, issues instructions to various mechanized areas of the distribution center 120 to ensure that the proper goods are placed in the proper totes for orders. Additionally, feedback from the distribution center 120 is used to

Like Figure 1, Figure 2 includes the web store 102, the order database 104, the inventory database 106, and the fulfillment system 108. Figure 2 also includes a publication system 210, a master product catalog 220, a route planner with geo-coding 240, an order management system 250, a mobile field device (MFD) server 260, an MFD 265, and a call center 270. The fulfillment system 108 includes an order management system interface 284, a pick and put-away planner 282, an automated material handling system 286, and a warehouse management system 288.

The elements of Figure 2 are coupled as follows. The publication system 210 communicates with the master product catalog 220. The master product catalog 220 communicates with the web store 102 and the inventory database 106. The web store 102 communicates with the route planner with geo-coding 240, the MFD server 260, and the call center 270. The order management system 250 communicates with the inventory database 106. The call center 270 communicates with the web store 102 and the order database 104. The warehouse management system 288 communicates with the order management system interface 284, the pick and put-away planner 282 and the automated material handling system 286. The MFD server 260 communicates with many mobile field devices such as MFD 265.

Each of the elements of Figure 2 is described in greater detail.

As noted above, the web store 102 receives orders from consumers. Generally, at the beginning of new orders, consumers are asked to select a delivery window for their order. To determine the available deliver windows, the web store 102 uses the route planner with geo-coding 240 to determine the available delivery resources and routes for the various trucks and vans needed to deliver an order to a consumer.

To show which items can be included in an order and that will be guaranteed to be delivered to the consumer in the selected delivery window, the web store 102 accesses the order database 104 to determine which items are available to promise.

To help make selections, the web store 102 provides additional information about the various items for sale through the web store 102. This information comes from the master product catalog 220. The master product catalog 220 is provided with information from the publication system 210. Product information is fed into the publication system 210. Many different types of product information can be fed to the publication system 210.

The master product catalog 220 can include other types of information (e.g., manufacturer, handling instructions, etc.). Each product in the master product catalog 220 includes a number of attributes that holds its related information. Attributes can be assigned by product type, for example. In some embodiments, the attributes are defined in metadata so that the new categories, or information, can be assigned to different types of data "on the fly." For example, books will have information than food products, and different types of food products will have handling, chill chain etc. information.

The MFD 265 and the MFD server 260 allows people delivering the goods to the consumer to communicate with the computer system 100. The MFD 265 allows for point of sale completion of an order. The MFD 265 and the MFD server 260 communicate with the computer system 100 about the specific items in an order, the status of the order, order payment information, and/or handling of special circumstances, such as returns. This is described in greater detail below.

The call center 270 provides customer service support. For example, the call center 270 processes customer inquiries about the status of orders. The call center 270

also supplies account information and addresses billing issues. The call center 270 can gain access to the status of various orders, arrange for rescheduling of deliveries, and a number of other customer service-oriented tasks. One embodiment of the invention uses call center software from Remedy, Inc.

The order management system 250 watches the inventory database 106 and places automated purchase orders. The purchase orders can be fully automated or partially automated. If a purchase order decision is easily made, then the order management system 250 can automatically execute the purchase order for the various good. Where the purchase order is determined to be difficult to be made, for example where the size of the order is large or previous orders have been problematic for a particular good, then the order management system 250 can send an order to a purchasing agent to be reviewed. The past history of purchase orders can be used in determining whether a new purchase order should labeled as hard or easy. This can improve the efficiency of the purchase order process.

The order management system 250 can also be used for keeping track of financial and billing information. For example, the order management system 250 can bill for orders once they are delivered to customers. The order management system 250, for example, can bill credit cards when the MFD 265, through the MFD server 260, indicates an order has been delivered and the customer has approved the delivery.

The order management system 250 can be used to perform automated item pricing. For example, items can be priced by product type. Product type might be a special buy, an everyday low price, or a special advertised item. Additionally, competitor pricing can also be used in pricing of items. Pricing can also be done at the web store 102.

Returning to the distribution and delivery process, once orders have been made at the web store 102, the fulfillment system 108 is used to ensure that the correct goods are put on the correct trucks at the correct time. Orders can be released immediately by the order database, or can be released in blocks with other related orders (this is described further below).

The fulfillment system 108 provides handling instructions and receives feedback from the distribution center 120. Additionally the fulfillment system 108 interfaces with the inventory database 106 to track the status of inventory in the distribution center 120. The warehouse management system 288 provides basic management of goods within the distribution center 120. The order management system interface 284 provides the interface between the inventory database 106/the order management system 250, and the fulfillment system 108. The pick and put-away planner 282 determines how goods should be stored in the distribution center 120 and how they should be placed into various totes to fill orders. The automated materials handling system 286 provides specific instructions to the distribution center 120 machines and operators for fulfilling orders and for storing inventory in the distribution center 120.

Each of the above elements will be described in greater detail below.

In some embodiments of the invention, include multiple distribution centers 120 that are supplied with control information from multiple computer systems 100, or parts of such computer systems 100. In such a system, one or more web stores 102 could present one or more interfaces to consumers. Through these interface(s), consumers can access the system from anywhere and have deliveries made to anywhere that zones are supported from various distribution centers 120. Tiered

inventory management and cross-distribution center inventory management can then be supported in such systems.

Various embodiments of the invention can include a data warehouse (not shown) that couples to the various elements of computer system 100. The data warehouse information can be processed and fed back to the web store 102 and/or the order management system 250, for example, to create specials for various items or to take advantage of special buying opportunities.

D. Electronic Commerce Site

Figure 3 is a summary of the shopping flow for the electronic commerce site of some embodiments of the invention The exact flow of a consumer's experience through the electronic commerce site will vary based on consumer selections The web store 102 is an example of an electronic commerce site The web store 102 provides the interface for the consumer and helps guide the consumer through the shopping flow of Figure 3.

The legend 300 accompanying Figure 3 indicates functions of the electronic commerce site that can be accessed at any time: registration 302, searching for products 304, check out 306, account management 308, exit the store 310, schedule a delivery 316, manage shopping cart 314, and shop 312. For each of these functions, the shopping flow diagram shows the entry point. The functions will described in conjunction with the overall discussion of the shopping flow.

At step 320, the process starts when a consumer enters the electronic commerce site In some embodiments, the web store is entered using a browser such as Netscape Navigator™ from Netscape Communications, Mountain View, CA, or Internet Explorer™ from Microsoft Corporation of Redmond, Washington. The web

store can be accessed using a uniform resource indicator (URI) corresponding to the web store, e.g. "http://www.example.com/".

The shopping flow either continues to customer identification and registration at step 322 or to step 324. The consumer can identify and/or register herself/himself at step 322. For existing consumers, this process may involve providing an identifier and/or a password. The identifier and/or password may be saved on the users computer such as with a cookie. For new consumers, registration can be carried out using the progressive registration system described below. After identifying herself/himself, the shopping flow continues at step 324.

At step 324, the electronic commerce site determines whether or not it recognizes the consumer. If the consumer is recognized, the shopping process continues at step 324. If the consumer is not recognized, the shopping flow continues at step 328.

At step 326, the consumer is prompted to provide at least a portion of her/his identifying information. This is the first part of the progressive registration process. It is not necessary to fully identify name and address to proceed, only a zip code is requested. The zip code is used to provide appropriate availability information for items and delivery times during shopping. Also, if the zip code falls outside the distribution areas, the consumer is notified at this stage. This prevents the consumer from preparing an order she/he can not have delivered.

At step 328, the user is able to schedule their delivery before they shop at step 330, otherwise the shopping flow continues at step 332. The advantage to re-scheduling the delivery prior to shopping is that the availability of items shown to the consumer reflect distribution and delivery resources, as well as the current inventory. Pre-scheduling the delivery also allows the electronic commerce site to display the cut

off time for placing the order based on distribution and delivery resources and planned routes. For example, delivery from an Oakland distribution center to Tiburon in Marin County may have an earlier cut off time than an order for nearby Berkeley.

At step 330, the consumer can schedule the delivery time prior to shopping using the process described below. The shopping then continues at step 332.

At step 332, the consumer can shop the electronic commerce store and add items to a shopping cart. The consumer can browse through the products available at the web store 102. The browsing can be through categories displayed in a hierarchical fashion. The browsing can be through virtual spaces such as a virtual aisle. The web store 102 can support searches as well.

The consumer can use past orders and lists to build new orders. Past orders can be recalled and used as templates for new orders. For example if a previous order included: ten item A, one item B, and three item C, the electronic commerce site can display the past order as a template allowing the user to provide new quantities -- including zero, for the current order.

Lists provide a similar functionality with predetermined collections of products. Lists could be generated by the consumer, e.g. "My Superbowl Party List", with items for a particular event or be provided by others, e.g. "Low Cholesterol Foods Council List". In either case, the consumer can manage her/his lists as part of the account management area 308. The consumer can adjust the items in the lists through that area. The lists can be used as templates for the current order.

The search feature allows a consumer to identify products for sale in a variety of fashions. For example, the consumer can search for categories of products, specific products, and/or on other attributes, e.g. on sale, every day low price, new, etc. At

step 336, if the requested item cannot be found, the process flows to step 338 where the consumer can either choose to exit the store or continue to shop.

Home meal kits are an additional shopping option of the electronic commerce site. Home meal kits are prepared meals typically including main courses, side dishes, and/or other goods. The consumer is presented with a template showing the contents of the meal. The consumer can adjust the number of meals requested as well as the contents of the total order. For example, the "Baked Chicken" meal kit might include a breast of chicken, potatoes, snap peas, and a brownie dessert. The consumer can be presented with a template to select how many people will be eating dinner, e.g. two. Also, she/he can adjust the quantities of items, e.g. two servings of mashed potatoes but no snap peas.

If items were found by the search, at step 340, the consumer can select from the found items for addition to the shopping cart. At step 344 the consumer can continue to shop at step 332 or check out at step 346.

At step 346, the consumer can check out her/his products. The check out process includes providing payment for the order. In some embodiments, the consumer can split the order across multiple delivery times and/or select different payment methods for different items.

Next, at step 348, if billing and shipping information is not already on file, the process continues at step 350, otherwise the process continues at step 352. The progressive registration process allowed the consumer to delay providing all of her/his information until this point. Further, at this point, any information already provided can be pre-filled into the registration screen to eliminate redundant data entry.

If upon completion, the order is less than the reserved number of totes, the additional resources are released for use by other consumers. However, if as the consumer adds products to her/his order, and exceeds the number of totes reserved, the system can reserve additional totes. At step 356, the delivery schedule can be checked a final time.

For example, it might be observed that seventy percent of orders have three large totes and two smaller totes. Further, this may be further broken into ambient temperature totes, refrigerated totes, and frozen good totes. This type of estimate could be used for the initial reservation of delivery and distribution resources. However, if a consumer added ten cases of soda, the electronic commerce site can reserve additional distribution and delivery resources. Additionally, information about the buying patterns of a particular consumer can be used to estimate the resources needed. Additionally, externals factors can be used to estimate the resources needed. For example, if the number of totes per order varies with seasons, days of the week, time of the day, and/or other factors, these factors can be used in reserving distribution and delivery resources.

In some embodiments, the reserved resources are checked only when items exceeding a certain volume or weight are added to the order. In some embodiments, the reserved resources are checked after every item. In some embodiments, no checks are performed until step 356 at which time the actual delivery and distribution resources are computed.

2. Progressive Registration

The electronic commerce site allows for progressive registration, or identification. This eliminates the need for the consumer to provide all of her/his information prior to ordering, or at the end. Further, it allows the shopping experience

to be customized for new consumers as well as existing consumers. Information acquired through progressive registration is not requested again from the consumer unless they wish to change their information.

E. Order Database

The web store 102 uses the order database 104 to make and keep track orders in the system. The order database 104 is a structured repository of information about orders. The order database 104 is coupled in communication with the inventory database 106. This allows the selection of a quantity of a product by the consumer to reserve that quantity of inventory.

For example, if there are only three bottles of a wine in the inventory of a particular distribution center, a consumer's selection of three bottles will reserve those bottles for that consumer. Another consumer attempting to buy a bottle of that wine will not be able to do so from current inventory while the reservation is valid. If the consumer does not confirm their order within a predetermined period, the reserved items are released; although, the order can be maintained. Thus, if a consumer returns later, they can continue shopping; however, the items in their cart may need to be rechecked for availability. Confirming an order preserves the reservation, thus ensuring that the consumer receives the inventory items.

The order database is also accessible to the mobile field device 265, via the mobile field device server 260, and to the call center 270. In both cases, the accessibility of the order information allows consumer inquiries and questions to be easily handled.

One organization of the order database 104 is as follows. In the following organization, logical business objects are stored in the web store 102 because these

objects tend to be accessed by the web store 102 most often. However, the business objects could be stored in the order database 104.

The foundation for the order database is the Oracle 7 (or Oracle 8) database. Built on top of the database is a number of business objects. The business objects encapsulate the concept of a user, a shopping cart, an order, a catalog, and a delivery. The user object represents a user of the system (holding all of the relevant user information). The shopping cart object represents where users place items that they want in an order. The catalog object holds the availability information of various items. The order object corresponds to a committed the shopping cart (the list of items from the shopping cart that are committed to be delivered to a customer). The delivery object shows the availability of scheduling. Each object is programmed to understand its business process, but to perform higher level functions, additional layers are added.

On top of the business objects layer, additional functionality can be implemented for the various subsystems in the computer system 100. For example, a shopping engine, for the web store 102, coordinates shopping activities between objects. This layered approach can be extended to provide a shopping interface for the web store 102. (Other embodiments can include other interfaces, such as a fax interface, an email interface, a telephone interface, a handheld organizer interface, etc. for interfacing with the shopping engine).

F. Route Planning

As part of the determination of available delivery resources, the route planner with geo-coding 240 is used to determine the correct route to deliver goods to a consumer. A route is assigned to a vehicle. A route has a driver and includes a series of stops. A stop can be to a customer address, a station, and/or some other location. For example, a stop might include a van driving to a customer address, a truck driving

to a station, and a truck making a pick up at a vendor on its return to the distribution center. The tables below show a sample van route and a sample truck route:

Truck Route

Route #	12345
Route Name	North East
Departure Date	Thursday 1/2/99
Vehicle	Truck 16
Driver	John Doe

Stop Address	Arrive	Leave
0 Area DC 1	10:40	11:10
1 Walnut Crk CrossDock	11:45	12:05
2 Concord CrossDock	12:25	12:45
3 San Pablo CrossDock	13:15	13:35
4 Berkeley CrossDock	13:45	14:05
5 Area DC 1	15:05	

Van Route

Route #	23456
Route Name	Orinda West
Departure Date	Thursday 1/2/99
Vehicle	Van 53
Driver	Mike Smith

Stop Address	Arrive	Leave
0 Walnut Crk CrossDock	12:10	12:25
1 Customer - Jones	12:30	12:40
2 Customer - Angel	12:50	13:00
3 Customer - Stewart	13:05	13:15
4 Customer - Moritz	13:25	13:35
5 Walnut Crk CrossDock	13:50	

In the above example, truck route 12345 is a parent route to the van route 23456. If the truck contains a tote for a customer in the van route, e.g. the tote for Customer - Jones, then this relationship can be seen in the itinerary for the tote. For example, a tote could have an itinerary as shown by the following table.

Tote Itinerary

Tote		LR88888
Shipment		Jones 123
Customer		Jones
Itinerary	Truck Route	12345
	Van Route	23456

Usually a tote for a consumer is transported by truck from the distribution center to a station or cross dock, and then on a van route to the consumer's address.

A single shipment may be split across multiple Parent Routes. For example, the mid-afternoon trucks may be half empty, but the early evening trucks may fill up typically. Therefore, ambient totes for the early evening deliveries could be placed on mid-afternoon trucks.

Route stops have planned departure and arrival times. For the first stop, the difference between the arrival and departure times is the planned loading time. The time between the arrival and departure times for the last stop include time for unloading and check-in as needed.

As deliveries are made, actual times for each stop are recorded including begin unload time, complete unload time, transaction complete time, and/or other times. These times can be used to adjust future route planning decisions. As actual information is received, delivery information for an order can be updated. For example, if the truck is late to the cross dock, the delivery information can be updated for consumers with orders having totes on that truck. Based on certain pre-defined parameters, an electronic mail message could be generated, a phone call could be made, a page could be sent, and/or some other action could be taken to notify the consumer.

The number of stops in a delivery window is fluid. It is based on the drive times, delivery and load times, and/or other factors, e.g. past delivery experiences. For example, a destination with a long drive time may only allow for a single delivery in a window of thirty minutes. In contrast, multiple deliveries in a subzone might typically allow three deliveries in a thirty minute window.

The size of a subzone is such that the drive time between stops, varying depending on customer and population density, is between one and ten minutes, (other embodiments include other ranges, e.g. ten seconds to an hour). However, any particular subzone may be larger or smaller to allow for adequate delivery resources for that subzone. These factors allow the delivery window availability to be calculated for a subzone ahead of time. In some embodiments, this information is used to provide information about delivery resources when consumers schedule a delivery on the electronic commerce site. Van departures can be staggered to provide delivery availability at all delivery windows, including those close in time to the arrival of trucks at the station.

Timing considerations for planning truck routes are also important. A typical truck to station trip can take anywhere from a few minutes to several hours. In some embodiments, truck routes take an average of thirty to ninety minutes to reach the first station. These timing factors are considered in the table below:

Action	Time	Time	Time	Time	Time	Time
Route Planner Releases Load for Distribution	1 min	10	30	30	30	60
Plan, pick, assemble	10	60	60	100	100	500
Load dollies to truck	0	10	20	20	20	60
Drive to Station	0	20	30	30	90	500
Unload Truck	0	10	20	20	20	20
Load Van	5	10	10	10	10	20
Drive to first stop	2	5	10	10	20	30
Total	18	125	180	220	290	1190

The actual times may vary and historical data can be used to adjust route planning, and delivery cut off times. In one embodiment, the average truck to station times of thirty to ninety minutes are initially used to define 220 to 290 minute cut-offs for zones. These cut-offs are further adjusted based on actual delivery times.

Route planning can occur based on customized values for a particular distribution center, zone, or subzone. For example, the length of time in a delivery window can be shortened or lengthened. In one embodiment, half hour deliver times are used. In other embodiments, delivery windows from ten minutes to an hour are used. Other customized values include scheduled delivery hours, days of the week, delivery fees, and/or other fees and charges. For example, in a particular zone or subzone which serves a predominantly Orthodox Jewish community, their might be limited delivery hours on Saturday.

In one embodiment, deliveries are scheduled between one o'clock p.m. and ten o'clock p.m. In another embodiment, local laws are observed to limit deliveries to legal hours. In another embodiment, deliveries are available throughout the day.

In one embodiment, delivery fees are tiered based on the total value of the order for example: < X, full fee; X to Y, partial fee; > Y, free delivery. Several values for X, Y and delivery fees used in some embodiments of the invention are laid out in the table below.

Fee Schedule	Full Fee	Partial Fee	Free
Schedule 1:	< $50: $2	$50-$100: $1	> $100
Schedule 2:	< $30: $5	$30-$50: $3	> $50
Schedule 3:	< $20: $10	$20-$75: $5	> $75

The actual delivery fee schedule may have more tiers, may be based on a percentage of the total value, or some other system. In some embodiments, the tiers are the same as the ones shown, but a larger fee is charged. Because the fee is selectable on a subzone basis, a rural subzone might use schedule 3, while another subzone might use schedule 2.

In some embodiments, between five thousand and twenty thousand orders are scheduled out of a distribution center per day. This is based on the delivery and distribution capacity of the distribution center and its associated delivery resources. In some embodiments, between fifty and five hundred vans are scheduled to perform deliveries each day for a single distribution center.

In some embodiments, the route planner can provide a list of available delivery windows to the web store 102 in under ten seconds. In some embodiments, the available delivery windows can be provided in less than two seconds. In some embodiments, routes can be planned, and replanned, in under a minute. In some embodiments, routes can be planned, and replanned, in under five seconds.

G. Put away and Pick Planning

The process of delivering goods to customers has been described; however, an important feature of the system is handling the intake of goods into the system and having those goods put into the correct tote, truck, and van.

1. Put Away Planning

The distribution center 120 systems plan for the put away of items received into inventory. The system takes into consideration the attributes of a SKU to determine a storage location. The attributes considered may include how soon the item is expected to be sold, temperature type, dimensions, fragility, weight limits of totes and trays, conveyability, and/or other factors.

For example, these attributes get specialty items like cigars to humidor storage area, flowers to a flower storage area, and fresh poultry for use in prepared foods to a poultry storage area.

In some embodiments, the system calculates a default put away area for each product. This determination is based on product attributes and product velocity, e.g. how fast the product sells. The default put away area can be periodically re-calculated to take into account new velocity data and other changes.

Once a product has been received, the system locates an available location within the default put away area and assigns the received inventory to that location. For example, each carousel has a number of shelves with locations on the shelves. The system selects an empty shelf location for the tray with the product.

In some embodiments, the high velocity, or fastest moving, items are assigned to mech pod locations.

For carousel bound items, the system determines a put away location taking into account the weight attribute of the product. Accordingly, heavy items are

assigned to lower shelves and light items are assigned to higher shelves. The easily accessed arm-level area can be reserved for faster moving items.

Fragile products are planned for pick last, since the pick operations may be limited by the layout of the pods and the conveyor system, fragile items are assigned to pods accordingly. Therefore, a fragile item will be placed in the last pod or pods in a temperature zone. For example, if there are three chilled good carousel pods, the more fragile chilled goods would be stored in the third and final chilled good carousel pod reached by the conveyors.

In some embodiments, the system selects the smallest locations that can hold the inventory being put away. The system takes into consideration the volume, or cube, of the item when it plans its disposition and does not recommend a location that would be too small. Additionally, locations that would be wasteful of space, e.g. too large, are avoided but can be used if no more appropriate sized locations are available.

In some embodiments, inventory is assigned to put away locations to balance the picking workload across pods.

For non-conveyable items that are going out for delivery within a predetermined time, the system sends the inventory directly to floor locations on the outbound dock. This process eliminates the intermediate put away and pick steps.

In some embodiments, if inventory of the same SKU already exists in a location, the new inventory is merged with it. In doing this, expiration dates are taken into account when appropriate.

2. Pick Planning

The pick planner determines the activities required to assemble a tote or a group of non-conveyables, e.g. items not transportable by the conveyors, to fulfill a shipment on time.

a) Item Picks

The pick planner allocates stock from locations in the distribution center to fulfill consumer orders. It may create multiple pick tasks to fulfill one line item of an order. In order to reduce the number of pod stops, the pick planner attempts to allocate stock from locations close to each other. Accordingly, if a product is in multiple locations, the system will prefer the location to which the shipment already has a pick task.

The order of pick tasks for a tote can take into account the pod order. For example, the picking order in the ambient pods for a tote might be Pod 4, 6, and 9, but not 6, 4, and 9. This prevents the re-circulation of totes in the conveyor.

A pick task can include a quantity, the location, the SKU, the expected weight range, a due time, special instructions, and/or other information. The total quantity on a shipment may be split between totes. For example, fifteen bottles of the same wine might require multiple totes. The SKU data is used for scanning, when requested. It can also be used to display a short description on the carousel annunciators. The expected weight range can be used as a quality check. The due time is the time the tote should reach the final stop. Special instructions allow for messages and special handling.

For example, non-food items being stored in totes with food items may be bagged. A special instruction can be used to trigger the bagging activity.

Other messages may be used to trigger a quality control check. The pod where this will occur is selected by the pick planner in some embodiments. The timing of a quality control check will be determined based on the prices of the items in the tote, a sampling system, e.g. to ensure a certain number of spot checks, the current work load

within the distribution center, the quality of work of the individual operators who added items to the totes, and/or other factors.

Messages can be used to trigger gift wrapping of one or more items in an assembled tote. The pod where the gift wrapping will occur is determined by the pick planner in some embodiments of the invention.

The pick planner can trigger put away tasks if the stock needed is in a receiving flow rack. The pick planner triggers the unload of the flow rack lane which allows the put away to be completed. If the stock used to fulfill a Shipment Line Item is subject to the stock being put-away, or transferred from a reserve location, the pick task is identified as dependent on the successful completion of that other task. The pick task will not occur until the completion of the other task.

b) Cartonizing

The pick planner can identify the types of totes required for a shipment. This will be based on the size and temperature type of the items. The pick tasks can then be cartonized, e.g. picks for a shipment are associated with totes.

The pick planner uses the cube, e.g. volume, and/or weight capacity information of a tote together with the corresponding information about items to prevent overfilling.

The pick planner sequences the release of totes within a shipment, within a load, and across loads within a distribution center. The release of totes does not require human intervention in normal operation. The release times are planned to allow an entire truck worth of totes to be packed and placed in the outbound dock prior to the departure of the truck.

c) Load Planning

The load planner receives shipment details from the pick planner. These details include the number and sizes of totes in each shipment, truck route and/or van routes/stops. Using this information, the load planner plans the staging of totes, building of dollies, and loading of vehicles.

The outbound dock, and more specifically a lane at the outbound dock, is the last stop for a tote before loading, in some embodiments. For non-conveyables, e.g. items that can not be moved by conveyor, the last stop is a floor space location on the outbound dock.

The load planner can determine what totes should go on a dolly and how many dollies to build. This is translated into instructions for the outbound dock operator to place totes in specific floor locations. A stacked dolly almost always contain only totes for a single van route in normal operation.

Non-conveyables are not stacked on dollies. When planning the loading of non-conveyables, the greater of the cube of the item or the cube of the smallest dolly can be used. At a minimum, the footprint used is that of the smallest dolly.

The load planner can determine the sequence in which dollies should be built and loaded onto trucks. The dollies should be sequenced in reverse stop order so that the first dollies built and loaded are for the last stop on the truck route. Non-conveyables are the last items loaded in each temperature section of the vehicle.

Some trucks may have movable dividers that separate ambient and chilled spaces. The load planner can calculate the placement of the refrigerated and/or ambient dividers for each truck load.

In some embodiments, for a given truck load, the ambient and chilled totes for a given truck load are in mirrored shipping spurs, that is, they are in the same relative

position. For example, the third shipping spur in ambient outbound dock and the third shipping spur in the chilled outbound dock would have dollies for the same truck load.

H. Automated Material Handling

In some embodiments, a commercially available warehouse management system 288 such as MOVE™ from Optum, Inc., White Plains, NY, is integrated with the pick and put away planners as well as an automated material handling (AMH) system 286.

The automated material handling system 286 interacts directly with the carousels and conveyors. The AMH 286 uses the warehouse management system 288 as a source of information to manage the conveyors and carousels.

The AMH 286 creates carousel and conveyor plans. These are the instructions sent to the respective systems to drive movement, actuate annunciators, and define paths. The plans can be derived from put and pick tasks. The carousels and conveyors produce results that are sent to the AMH 286, e.g. status, positions, traffic reports, and/or other results. A path is a type of conveyor plan having a series of pod destinations that a container should traverse. The path can include all stops, including the last stop, which for totes, is a location in the outbound dock. Traffic reports are one type of conveyor result. These are the readings from sensors along conveyor lines that can detect a stopped container, etc.

In one embodiment, the carousel system notifies the AMH 286 when a batch of containers in the carousel pod has been fully processed and can be released back onto the conveyor's sorter.

1. Path Types for Conveyors

In one embodiment, there are three possible path types: static, flexible, and dynamic.

A static path is a path with an ordered series of stops. Each stop is processed in the exact order as specified in the path. If a pod is full, then the container re-circulates until that stop can be made.

In contrast, dynamic paths are provided to the conveyors one stop at a time. When the stop is complete, or there is a failed divert, then the next stop is provided.

A flexible path is a path with a partially ordered series of stops. A flexible path includes information that tells the conveyor when this usual ordered series of stops can be overridden. For example, the path may state that the pod Stops are 2,3 and 6, and that it is OK to go to pod 6 before pod 3. This is would be used by the conveyor when there is an overflow condition in pod 3, for example. In that case, the tote could be directed to pod 6, rather than re-circulate to pod 3. After pod 6, the container would move to pod 3.

If the stops are flexible, then the AMH 286 may not know, in some cases, which carousel pod stop is the last one. When possible, the AMH 286 instructs the pod operator to place the tote on an express conveyor after the last stop.

2. Response Times

When the AMH 286 sends plans to the carousels and conveyors, the expectation is that in normal operations, the conveyor plans will be executed within a few seconds. However, longer delays of up to a minute for releasing totes can occur if the AMH 286 sends many paths calling for the same tote type at a time. The carousels plans are executed when the containers arrive in the carousels.

The conveyors and carousels provide notification to the AMH 286 of completed actions and problems. The AMH 286 in turn can send a correction, e.g. additional or new plans. An exception to this is if a problem requires a manual activity.

3. Components of Plans

In the carousel plans, the AMH 286 includes instructions for the carousels to display the appropriate information on the annunciators in the pods.

In some embodiments, the AMH 286 relies on the task manager, e.g. MOVE™, to manage dependencies between picking and put away. For example, the task manger will not allow picking of items that have not been put away. In some embodiments, the AMH 286 also relies on the task manager to prioritize tasks.

The AMH 286 times the release of plans to the conveyors and carousels, including the automatic induction of totes according to the pick plan. The release should be coordinated so that totes reach the outbound dock prior to the due time. However, totes should not be inducted too early. This prevents starting totes, that contain fresh, highly perishable foods, and/or hard-to-keep-frozen foods, too early. It also prevents the induction of totes before a product is put away or, for prepared foods, before their preparation is complete. The pick and put-away planner 282 may include a start time in the tote plan to assist the AMH 286 in inducting the tote.

The AMH 286 can be programmed to work in a just in time (JIT) fashion to send out enough work to prevent the under utilization of the carousel pods without getting far ahead in the induction of totes. In some embodiments, the AMH 286 uses historical experiences to calculate the amount of time to process carousel and conveyor plans.

Containers that the conveyor system does not recognize are pathless containers. The conveyor will send a message noting the pathless container and the AMH 286 will attempt to re-route the container. If that is not possible, the AMH 286 will direct the container to an appropriate temperature environment for exception handling.

4. AMH - Conveyor/Carousel Path Selection

In some embodiments, each carousel pod has two inbound conveyors, an upper conveyor and a lower conveyor. The AMH 286 conveyor plan can indicate which conveyor is to be used. In one embodiment, the following rules are used to determine which conveyor to use. The first rule is that if a container, because of its type, e.g. shape/weight, requires one of the two levels, then that conveyor is used. The second rule is to position totes for which the current pod is the last stop on the upper conveyor, which is adjacent to the express conveyor. This second rule can be modified based on the current use levels of the conveyors, e.g. the lower conveyor at least X% full and upper not more then Y% full.

5. AMH - Conveyor Responsibilities

The conveyors manage container movement on the conveyor equipment. The conveyors direct the movements of containers into and out of the pods. In some embodiments, the conveyors precisely positions containers in a batch on both the upper and lower conveyors inside the carousel pods. All of this processing is handled without direct interaction by the AMH. The AMH provides destinations for specific containers and the conveyors do the work.

In one embodiment, the conveyors route a container to a destination until a destination task complete message is received from the AMH 286. This ensures that a

container will not continue to the next destination in a path until all tasks are completed at the current destination.

The conveyors are able to induct totes at the direction of the AMH 286 from tote release areas. The plan provided by the AMH 286 will not include an identifier for the tote, but rather a tote type. The tote identifier is scanned by the conveyor prior to being inducted out of the tote release area, and the identifier is supplied to the AMH 286 for further use.

If the tote in the release area is not the correct type, an exception can be raised and the tote may be held until the exception is resolved. In some embodiments, additional tote releases can continue while the exception is handled. In some embodiments, the tote is held until the right type of tote is available. In other embodiments, the release is held until the right type of tote is available.

The conveyors automatically re-circulate containers when they are not diverted into their destination as a result of an overflow, or some other condition. The re-circulations can be reported to the AMH 286 either immediately on diversion, or when the container is resorted.

The warehouse management system 288, e.g. MOVE™, may include a maximum and a minimum gross weight for each container. For totes, this is the expected weight range when the picking is complete, or at an intermediate stage. For trays, this is the expected weight range when coming out of receiving. This information can be included by the AMH 286 in the plans for verification and quality assurance by the conveyor system. Containers not falling within the expected weights can be redirected for exception handling, e.g. shortages and overages.

6. AMH - Carousel Responsibilities

The AMH 286 coordinates the movement of the carousels with the arrival of trays and totes on the conveyors. Ideally, the AMH 286 will have the carousel rotated for access to the correct location as the operator begins a task. For example, in a put away task, the AMH 286 will rotate to the correct location while the operator lifts the tray from the conveyor.

One component of this process is identifying when to allow the carousels to rotate, e.g. when is one task finished so another can begin. For put away tasks, a single task complete button press can be used to indicate that the put away is complete. For pick tasks, a similar button press can be used to indicate that the item has been placed into the tote. One further optimization is to provide a task complete button near the carousel. The operator can press the task complete button near the carousel when she/he takes the item from the tray, thus allowing the carousel to begin rotating to allow access to the next destination. In this embodiment, the AMH 286 will wait for a second task complete button to be pressed after the item is in the tote.

The put away and pick tasks can be optimized in several ways. In one embodiment, picks are performed first. In another embodiment, put-aways are performed first. In another embodiment, the pick and put-aways are interspersed to optimize carousel rotation.

In some embodiments, the item may need to be scan checked on either pick or put away based on parameters, e.g. cost of item, spot check of inventory, and/or other parameters.

When a tote is at its last pod stop, it is usually positioned on the upper conveyor in some embodiments. The AMH 286 instructs the carousels to tell the operator to put the tote onto the express conveyor.

The AMH 286 plan will include messages to the carousels to notify the operator to bag items when appropriate.

7. AMH - Implementation

In some embodiments, the AMH 286 models the sequence of messages sent, and expected, using a modified finite state machine. More specifically, each container can be thought of as traversing a set of states. At each state, one or more messages is sent and/or information is updated. The transitions between the states are invoked by inputs, e.g. a message sent, acknowledged, and/or a specific state reached, e.g. last stop, etc. Each state can be associated with a function that is executed upon entering the state. The transition to the next state occurs when the function sends one or more messages. In some cases, the function may specify the next state.

The AMH 286 also includes communications capabilities for interacting with, sending messages to, and/or receiving messages from the carousels, the conveyors, the pick and put-away planner 282, and the warehouse management system 288. These communications can be managed asynchronously so that the AMH 286 can continue to send commands as messages, e.g. execute functions, while also receiving messages. Priority based queues can be used to ensure that the AMH 286 acts on higher priority items before lower priority items.

I. Distribution Center Layout

Figure 4 shows a layout of a portion of a distribution center according to one embodiment of the invention. The portion of the distribution center shown in Figure 4 is for ambient temperature goods only. Refrigerated and frozen goods are kept in temperature controlled pods having similar layouts. The layout shows the procedural linkages between elements the distribution center 120, each distribution center 120

will have a physical layout according to the configuration of the particular physical space.

1. Inbound Dock Operations

Products arriving from suppliers, wholesalers, distributors, and other sources, arrive at the inbound dock 600. The inbound dock 600 can accommodate a variety of motor vehicle types. In some embodiments, the distribution center 120 may include facilities for receiving shipments by rail. Products are removed from the shipping vehicle onto a pre-receiving stage 602. In some embodiments, one or more inbound dock operators 622 supervise and/or perform this process.

In some embodiments, multiple inbound docks and/or pre-receiving areas are available for different temperature goods. In some embodiments, a refrigerated and an ambient inbound dock and pre-receiving area are present. In this embodiment, priority is given to the receiving of frozen goods over refrigerated goods, for chill chain control.

The inbound receiver 622 can verify the load item count. When a shipment arrives, the driver presents the manifest to the operator. The manifest shows the purchase order number(s) and a description of the shipment. In some embodiments, the inbound receiver 622 does not check shipments to the item level, rather the general description of the shipment, such as 4 pallets, or 50 mixed cases is recorded.

The inbound receiver 622 can check the shipment for obvious damage. If damage is found, that portion of the shipment can be rejected. The inbound receiver 622 also checks the temperature of chilled items. If the goods require further inspection or grading, the inbound receiver 622 can mark the shipment to receive additional treatment.

Any discrepancies between the manifest, the shipment, and the purchase order information can be noted on the manifest. In some embodiments, the driver is required to sign the manifest. The inbound receiver 622 can handle refusals of shipments, which occur because of substandard quality, temperature, lateness, and/or other reasons. In some embodiments, the inbound receiver 622 is instructed by the distribution center systems to refuse a shipment based on lateness, substandard quality, temperature problems, and/or other reasons.

2. Receiving Operations

Receivers 624 are responsible for moving goods from the pre-receiving stage into staging areas for storage in pods, the storage areas of the distribution center. For products stored in a carousel pod, the receivers 624 remove products from their shipping cartons and place the products into trays at receiving 606. For example, Brand X potato chips 16 oz. bags may come packed in cartons of twenty bags. The receiver opens the carton and transfers the bags into trays.

The receivers 624 may have wireless scanners for reading the universal product codes (UPC) on products and communicating with the fulfillment system 108. Upon scanning an item, a suggested tray size and packing quantity may be provided. The receivers 624 can use scanners to indicate how many of a product are placed into a particular tray. Because each tray has a unique identifier associated with it, the automated systems can keep track of the location of the product. If the product is perishable, information about the expiration data of the product can be entered if appropriate.

The receiver 624 signals to the distribution center system the purchase order that is being processed. This is done so that as the receiver checks in items, reconciliation with the purchase order can be performed.

The basic receiving process in some embodiments is the scanning of the UPC of each of the received SKUs.

The receiver 624 is notified when the expiration date of a product should be captured. In some embodiments, these values are input as part of receiving the product. In some embodiments, the system prohibits consolidating like products with different expiration dates in the same tray and/or the same location within a pod.

When required based on the SKU, the receiver 624 is notified that they should bag an item.

In some embodiments, the system determines the optimal tray size based on the size of the SKU, the quantity ordered, and whether or not the inventory is to be merged with existing inventory of the same SKU.

In some embodiments, if a received item is needed to fulfill a shipping order, the receiver 624 is directed to place the tray on the conveyor instead of in the receiving flow racks. If the item is a non-conveyable, the receiver 624 is instructed to put the product in a put away stage location designated for hot put away items.

In some embodiments, the receiver 624 can view an image of the SKU being received. If the image of the SKU and the appearance of the actual SKU do not look the same, then the receiver 624 can indicate this.

The receiver 624 periodically unloads trays from the flow racks that are part of the put away staging area 608 and places them onto the conveyor to be put away. The receiver can scan each tray as it is unloaded. This triggers the put away planner to create a put away task for the product. The unloading may be driven by demand from pick tasks as well as distribution resource management concerns such as: managing conveyor capacity, optimizing carousel movements, maintaining space within receiving 606 for additional shipments, and/or other factors.

a. Carousel Pod Receiving

For carousel pod receiving, the receiver 624 a tray large enough to hold all the received inventory of a single SKU. If all of the received inventory cannot fit into a single tray, then the receiver placed the inventory into two or more trays. For each tray being processed, the receiver 624 places the inventory in the tray, enters the quantity being received, and scans the tray.

The tray is either placed directly on the conveyor and moved to the carousels for put away, or is placed in the receiving flow racks. This is an operational decision made by the receiver 624 in conjunction with the distribution center systems.

All cardboard and outer wrapping can be removed at receiving 606. This places the item in a ready to sell condition when it is put away.

b. Non-Carousel Receiving

For non-carousel receiving, the receiver 624 associates the quantity of the product being received with a tracking label. The items can be received in their original packaging. For example, twelve packs of soda are kept in their wrappings.

Once received, the non-carousel bound items are placed in the appropriate put away staging area 608.

c. Exceptions

Many special cases can occur during the intake process. For example, the received quantity is not always equal to the ordered quantity. There may be a shortage or an overage. System parameters can determine whether and how much of an overage is acceptable. If the overage exceeds those parameters, an exception can be raised to require supervisory intervention. In the case of a shortage, the amount received is entered. In some cases, an additional purchase order is automatically generated to complete the inventory to the required level. In some cases, history

information is kept about quantity and quality problems to facilitate vendor selection for future purchase orders.

The total quantity received at one time may only be a part of the total amount on the ordered line item. This is because the shipment may be large and the receiver 624 cannot locate all of a particular SKU. The remaining inventory could be received later in the processing of the shipment.

The receiver 624 checks in damaged product using the appropriate codes and the container can be automatically routed for quality control and review.

More than one receiver 624 can receive the same shipment at the same time.

3. Put away and Pick Operator Tasks

Mechanized pods and manuals pods are put away by put away/pick operators 626. In some cases, the goods are transported by conveyors 614 to the appropriate pod, e.g. the pod 616 or the pod 610. Alternatively, the operator 626 retrieves the good from the put away staging area 608 and transports it to the appropriate pod.

The carousel pod 612 receives its goods on trays via the conveyors 614. When the tray was removed from the put away staging area 608 onto the conveyors 614, an appropriate put away task was generated for the tray. The tray will arrive in the appropriate carousel pod, e.g. the carousel pod 612, and the carousel can be positioned to allow access to the specified put away location.

a. Carousel Pod Operator

As noted above, the put away and pick activities may be interspersed with one another when they are performed in the carousel pods. This means that the operator will have put away tasks interspersed with pick tasks. Actions may be guided by annunciators such as a monitor, audible indicators, and/or visual indicators.

As noted above, in some embodiments, a task complete button is provided to signal that a task is complete. This causes the system to display the next action and allows the tray or tote to be moved by conveyor to the next destination. For example, in front of the carousel pod 612, there might be two conveyors, each with eight stopping points. Trays and totes will arrive at those stopping points, and the operator 628 is instructed to process put and pick tasks for those trays and totes in a specific sequence.

The basic put away and pick operations in one embodiment are: pick, hot pick, replenish, combine, and tray to conveyor.

For pick operations, the operator 628 in the carousel pod 612 is directed to pick a certain number of eaches from a tray. The carousel will automatically rotate to allow access to the appropriate item. Annunciators can point to the appropriate shelf and indicate quantities to pick. Additional annunciators indicate how many of the picked items are to be placed in each tray or tote currently stopped on the conveyor in the pod. The operator places the items in the appropriate locations. A pick may include several eaches for more that one tray or tote, this can be combined into one pick action.

For put away operations, a tray of goods is stored in the carousel by the operator 628. The tray that is to be put away can be indicated with an annunciator on the conveyors. An additional annunciator can indicate the tray put away location.

Hot picks are used to fulfill rush items, e.g. an addition to an order or a recovery from an exception. In some embodiments, the hot pick operation is given priority over other actions. Hot picks are typically loaded into an empty tray, and after scanning, placed on the express conveyor to the outbound dock areas 620.

Combine operations are used to move items from a tray on the conveyor into a tray on the carousels. Items being combined should have the same expiration date, or not be expiration date controlled.

The tray to conveyor operation is used to move inventory around the distribution center. The operator is instructed to move a particular tray to the conveyors for movement.

When new inventory arrives and is to be merged with existing inventory already in a carousel, a pick-put away combination can be used to merge the inventories. The pick operation is from the current carousel tray into the new tray. This ensures that the older inventory is placed on top of the new inventory. Then the merged tray is put away.

Cycle count operations can be generated that request that the operator 628 count particular merchandise quantities. This can facilitate inventory management.

b. Mech/Manual Pod Operator

The operation of mech pod 616 is discussed here, but the setup and operation of the manual pod 610 is similar, when appropriate differences will be noted.

The operator 626 may use a mobile device, different from, similar to, or the same as the mobile field device 265 , to assist in completing put away tasks in the mech and manual pods. The mobile device can provide scanning and instruction prompting operations. The mobile device may be adapted for attachment to clothing or the body. The mobile device assists in completing pick and put tasks.

The operator selects the non-carousel bound items located in the put-away staging area 608. The SKUs of the items are scanned with the mobile device and the operator 626 is notified of the assigned put away location, e.g. a put away task is generated. The location is within the respective mech pod 616 or the manual pod 610.

When the operator 626 places the items at the assigned put away location, she/he scans the location address label, which signals that the put away task is complete.

Totes for outbound shipment to consumers arrive on the inbound conveyor for pick tasks. The operator 626 can process one, or several, totes at a time and can use the mobile device to ascertain the pick tasks. When the mobile device is used to read the identifier associated with a tote, the pick tasks associated with that tote are provided to the operator 626 in the form of location, SKU, and quantity information. The presentation of items for pick operations on the mobile device may be optimized based on the layout of the pod. The operator 626 scans items as they are removed from the location to signal the completion of the pick tasks. In some embodiments, the operator 626 can scan the location from which the item is removed to signal the completion of the pick tasks. When all of the pick tasks for a tote are complete, the tote is moved to the outbound conveyors.

In some embodiments, pick tasks for items stored in manual pods for a truck route are grouped so that the operator will pick them at approximately the same time.

Cycle count tasks may be performed periodically to ensure accurate inventory records.

The operators 626 working in the manual pod may be responsible for sweeping fill to order items such as prepared foods and/or personally packaged items, etc., from locations throughout the distribution center and collecting them in the manual pod. In the manual pod, each fill to order item will be scanned, and a put away task generated to allow the storage location of the item to be known when it comes time to deliver the item into a tote.

4. Outbound Dock Operations

The outbound dock operators 630 processes totes leaving the distribution center for consumers by organizing them and preparing them for shipment in the outbound dock areas 620. Additionally, the operator 630 processes empty totes -- for return to the tote station 604, returned products and/or other things coming back from the stations.

In some embodiments, the time and effort of handling and organizing individual totes is optimized in preference to maximizing truck capacity. Accordingly, some dollies will not be completely filled. This will reduce truck carrying capacity, but reduce handling time and improve efficiency overall.

The dollies can be rolled into and out of the trucks by hand, machine, or a combination of the two. At the outbound dock areas 620, they are rolled into trucks. At the stations, they are then rolled onto vans. Thus, during normal operation, there is no tote by tote handling, or organizing needed once the tote is placed in the dolly.

In some embodiments, totes are not pre-sorted within a van route. This is acceptable, because there are not that many totes on a van route. For example, a large van route may have fifteen large ambient totes. It has been observed that selecting one tote out of a group this size will take less than fifteen seconds.

A shipping spur endpoint is a portion of the outbound dock areas 620. Each spur has a conveyor that allows totes for that spur to be pulled down. Each spur is associated with one or more doors where trucks can be loaded. In some embodiments, each shipping spur endpoint is organized so that it has a plurality of floor locations each large enough to hold the dollies for a single van route. For example, each floor location on the shipping spur might hold four dollies. Each shipping spur in turn will have multiple floor locations so that all of the van routes for a truck can be organized.

The distribution center 120 systems will deliver totes for a van route to the appropriate shipping spur by the conveyors 614 and/or manual delivery of the totes.

The operator 630 will prepare for a truck load by placing empty dollies in the floor locations. As totes arrive, their floor location is indicated. In some embodiments, the operator 630 uses a mobile device to scan the tote, and the mobile device indicates the floor location. At placement, the system may request that the operator 630 scan the tote and the floor location identifier to confirm placement of the tote.

The operator 630 can preview the truck route summary to check the status of the load items. The operator 630 can use this report to see which totes are not yet on the outbound dock.

In some embodiments, the next step, called palletization, is performed after all of the totes for a truck load have been placed on the dollies. The operator 630 matches totes to dollies. Exceptions will be noted if a tote is in an improper floor position, e.g. positioned for the wrong ultimate van route.

The operator 630 may also assist in loading dollies onto the trucks.

In some embodiments, a distribution center may have multiple outbound docks, one for each temperature zone, or simply refrigerated and ambient outbound docks. In these embodiments, totes are routed to the appropriate outbound dock for staging and loading onto trucks. The truck can make a stop at each of the outbound docks to receive all of the dollies for a load.

J. Delivery

Trucks drive to stations according to their routes. For example, a truck might be going from the distribution center in Oakland to the station, or cross dock, in Redwood City, followed by the station in Palo Alto. At the stations, dollies are unloaded from the truck and placed on the dock. The unloaded dollies are those

dollies which have totes for van routes served out of the current station. For example, at the Redwood City station, twelve dollies for van routes served out of that station might be unloaded onto the dock.

If any dollies contained totes with multiple destinations, the station operator would be notified and unload that tote. In normal operation, this should not be necessary.

At the station, the dollies can be positioned for loading onto vans. In normal operation, the totes on a dolly are all for a single van route. If any totes had to be moved, the station operator would be notified and the totes could be moved. As vans arrive, their dollies can be loaded from positions at the station. In some embodiments, the station is configured as a cross dock, having one area adapted for receiving trucks and another area adapted for receiving vans. This allows the dollies to be transferred from the trucks to vans without lifting the dollies.

Once the dollies are loaded onto the van, the van driver, as called a courier or delivery person, follows the van route to deliver the totes to consumers. The delivery route is pre-planned like the van route 23456 shown above. The van may include devices to provide navigational aides such as directions. Additionally, the courier may be provided point-to-point driving instructions at the time they depart the station. In some embodiments, the mobile field device 265 can provide navigational assistance. Once the courier arrives at a delivery address, she/he removes the appropriate totes from the dollies and brings them to the customer.

6 1. Van to Stop Process

The MFD 265 displays the upcoming stop, and includes delivery instructions provided by the consumer, as well as any system wide or shipment specific instructions.

Upon arrival at the stop, the courier notifies the system of arrival The MFD 265 displays the list of load items, e.g. totes and non-conveyables, being delivered at this stop. The courier can scan-check them with the MFD 265. After each scan there may be a sound and/or visual cue to indicate correct object, incorrect object and/or unload complete.

When unload complete occurs, the courier may be notified with a sound and/or display message, and the system updates the shipment information with this time.

If we are late making a delivery, a late credit may automatically be applied to the shipment. A predefined value determines how late a shipment must be before a credit is automatically applied.

In unusual cases, there will be a shortage of a load item, or part of a load item The courier can indicate the shortage, and the system updates the shipments. A shortage within a load item occurs when, for example, a tote on a dolly is missing

2. Tote to Door Process

If the customer is not at home, the courier can check the system to see if the shipment can be left at the door. The system will approve leaving the shipment if the following conditions are met: all of the Totes in the Shipment are ambient; there are no regulated SKUs that require verification of ID; the contents of the shipment are less than a certain predetermined dollar amount; and/or the consumer has agreed to accept responsibility for shipments left at door.

If the consumer does not answer the door, then the courier is able to get the recipient's phone number from the MFD 265. The MFD 265 can be used to call the consumer, and/or some other method can be used to contact the consumer.

If a SKU is being delivered that requires the verification of the age of the recipient, then the system can notify the courier. The courier can then enter information into the MFD 265 (e.g., that an acceptable ID was presented by the recipient, or mark that the customer appears to be over some pre-specified age, e.g., at least 30 years old).

The courier can indicate that a shipment is undeliverable if the recipient is not at home or the shipment can not be left at the door.

3. Managing Undeliverable Shipments

The courier can provide a reason for non-delivery using the MFD 265. If the reason is that the consumer cancelled the shipment at the door, then there is no attempt to reschedule the delivery. The shipment can be sent back to the distribution center 120, and appropriate handling charges, penalties, and/or service charges can be added.

For shipments that need to be re-scheduled, a message can be sent to a call center, to the consumer, or in some other manner to allow the shipment to be rescheduled. Depending on how quickly the delivery can be rescheduled, the shipment may be returned to the distribution center 120, or held at the station. Appropriate handling charges, penalties, and/or service charges can be added.

6

4. Returns

The courier can accept returns at the consumer's door in some embodiments. The MFD 265 is used to scan the tote(s) and/or item(s) to be returned. In one embodiment, this includes providing a deposit credit for the return of totes. The return can be out of previous shipments to the consumer. For example, if the consumer ordered a box of popcorn a week earlier, the consumer can return it in some

embodiments. The MFD 265 can access appropriate pricing information to process the return.

In some embodiments, additional restrictions are placed on returns to limit them to non-perishable items purchased in a predetermined period of time, e.g. two weeks, thirty days, etc. In some embodiments, the courier has discretion to override the MFD 265 and allow a return. Some common reasons for returns may include: change of plan (consumer no longer wants item); defective; not ordered; wrong item; damaged enroute; spoiled (no item will be returned by the customer); shortage (from a previous shipment, no item will be returned by the customer); and/or other reasons. Different rules may apply to different types of returns, and individual consumer return histories can be evaluated in deciding whether or not to accept a return.

5. Adjustments

The courier can handle discrepancies such as incorrect billings, shortages, overages, and/or other discrepancies. The courier can do this by selecting an item on the MFD 265 and indicating the adjustment and the reason.

If there is a late delivery credit, a redelivery charge and/or handling fee applied to a shipment, the courier is able to see these on the MFD 265. In some embodiments, the courier is able to approve and/or remove each one, depending on circumstances. For example, in some embodiments, a consumer's previous order history could be considered, e.g. first order in a year with a problem so remove the redelivery charge. The changes to the shipment made by the courier are forwarded to the order management system 250, and sales tax and/or totals can be recomputed.

6. Completion

In some embodiments, the courier reviews the total as displayed on the MRD 265 and indicates her/his approval.

The MFD 265 is ready for the recipient's signature and/or credit card, if required. The recipient views the total and the added adjustments on the MFD 265, and is asked to sign the screen of the MFD 265. In some embodiments, the courier approves that a signature has been captured and indicates this to the system. The order management system 250 now completes the sale with the credit card company. In some embodiments, the credit card is charged by the web store 102 at step 358. In some embodiments, the MFD 265 prints a receipt for the consumer once the credit card transaction is complete.

In some embodiments, regular customers may not be required to provide a signature. The system determines whether or not to require a signature based on the customer profile and/or other factors relating to the shipment, e.g. absolute dollar amount, relative dollar amount of purchase, and/or other factors.

In some embodiments, the receipt shows savings from the manufacturers suggested retail prices (MSRP) on the receipt. For example, if the consumer paid $50 for goods with an MSRP of $75, the receipt might indicate: "You saved $25 by shopping with us!"

K. Conclusion

The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to limit the invention to the precise forms disclosed. Many modifications and equivalent arrangements will be apparent.

CLAIMS

What is claimed is:

1. A system for distributing groceries to customers' homes, the system comprising:

a distribution center storing the groceries;

a delivery system having vehicles for delivering the groceries to the customers' homes; and

a computer system, during normal operation of the system, allowing customers to reserve delivery time windows on the same day orders are received, and the computer system providing the customers with guarantees of availability of the groceries for the reserved delivery time windows using inventory information about the groceries in the distribution center.

2. The system of claim 1 wherein the groceries include perishable products, frozen products, and ambient temperature products.

3. The system as recited in any of the claims 1 or 2 wherein the groceries include fast moving groceries and slow moving groceries, fast moving groceries are groceries that typically sell faster than slow moving groceries, and wherein the distribution center has non-carousel storage areas and carousels, and wherein fast moving groceries are stored in the non-carousel storage areas and slow moving groceries are stored in the carousels.

4. The system as recited in any of the claims 1-3 wherein the delivery system includes stations include frozen products and ambient temperature products.

5. The system as recited in any of the claims 1-4 wherein the groceries include frozen products and ambient temperature products.

6. A system for delivering goods, the system comprising:

a means for storing the goods;

a means for delivering the goods;

a means, during normal operation of the system, for allowing customers to reserve delivery time windows on the same day orders are received; and

means for providing the customers with guarantees of availability of the groceries for the reserved delivery time windows using inventory information about the goods in the means for storing.

7. A grocery distribution system, the system comprising:

a computer interface, the computer interface for receiving an order for a product from a consumer;

a distribution center, the distribution center including a storage area, the storage area including a conveyor and a carousel, the conveyor for receiving a shipping container and sending the shipping container to a destination with the product, the carousel including a plurality of products, the plurality of products including the product, the carousel automatically rotating so that the product in the plurality of products is accessible responsive to the shipping container being on the conveyor in the storage area, and the destination within the distribution center for transferring the shipping container to a dolly, and the distribution center for transferring the dolly to a truck, and

a station for receiving the number of dollies from the truck, and for transferring the number of dollies to a van;

the van for delivering the shipping container to the consumer.

8. The system of claim 7, wherein the storage area is kept at predetermined temperature.

9. A distribution center that during normal operation comprises:

a plurality of conveyors, the plurality of conveyors operating in an automated fashion;

a plurality of shipping containers, each of the plurality of shipping containers having a corresponding delivery destination on a corresponding truck route and a corresponding van route;

having shipping containers presorted at the distribution center onto dollies, therefore they do not need to be moved off dollies until taken to the consumer.

10. A method for delivering a product to a customer, the method comprising:

receiving a first signal corresponding to a partial identification of the customer;

responsive to the partial identification, displaying a plurality of available delivery times;

receiving a second signal corresponding to a delivery time in the plurality of available delivery times;

receiving a third signal corresponding to a selection of a product from a number of products, the number of products including information about availability of delivery of the corresponding product at the delivery time;

receiving a fourth signal confirming a purchase of the selected product by the customer and any additional identification information; and

responsive to the fourth signal:

transferring the product to a shipping container,

transferring the shipping container to a delivery vehicle, and

delivering the shipping container including the product to the customer

11. The method of claim 10, wherein prior to receiving the fourth signal, a plurality of signals are received selecting a plurality of products.

12. The method as recited in any of the claims 10-11, wherein the confirming the purchase of the selected product further comprises confirming the purchase of the plurality of products.

13. The method as recited in any of the claims 10-12, the transferring the product to a shipping container comprises:

determining a number of shipping containers necessary to hold the plurality of products;

releasing the number of shipping containers to receive the plurality of products; and

transferring the plurality of products to respective shipping containers in the number of shipping containers.

14. The method as recited in any of the claims 10-13, wherein the displaying a plurality of available delivery times is based on available delivery resources and available distribution resources, and wherein the plurality of available delivery times includes delivery times the same day.

15. The method as recited in any of the claims 10-14, wherein the partial identification is a zip code.

16. The method as recited in any of the claims 10-15, wherein the product is at least one of a food item, a fresh fruit, a vegetable.

17. The method as recited in any of the claims 10-16, wherein the shipping container is adapted for a refrigerated product.

18. The method as recited in any of the claims 10-17, wherein the shipping container is adapted for a frozen product.

19. A system comprising:

a carousel, the carousel having a plurality of locations adapted for storage, the carousel rotating to allow access to a portion of the plurality of locations;

a conveyor, the conveyor for transporting a container, the conveyor including at least one location in proximity to the carousel; and

a processor, the processor coupled in communication with the carousel and the conveyor, the processor including a program for coordinating the movement of the carousel with the conveyor, the program for rotating the carousel to allow access to a portion of the plurality of locations including a location for storing the container when the container is at the at least one location on the conveyor.

20. The system of claim 19, wherein the container is a shipping container, and wherein a product stored in the carousel is to be placed in the container, the processor includes a second program, the second program for rotating the carousel to allow

access to a portion of the plurality of locations including a location storing a container with the product when the container is at the at least one location on the conveyor.

21. A method for displaying availability of an item for a customer using a computer interface, the method comprising:

receiving a selection, the selection corresponding to a delivery window;

displaying the item as available if the item is in an inventory at a distribution center and the item can be transferred from the distribution center to the customer within the delivery window.

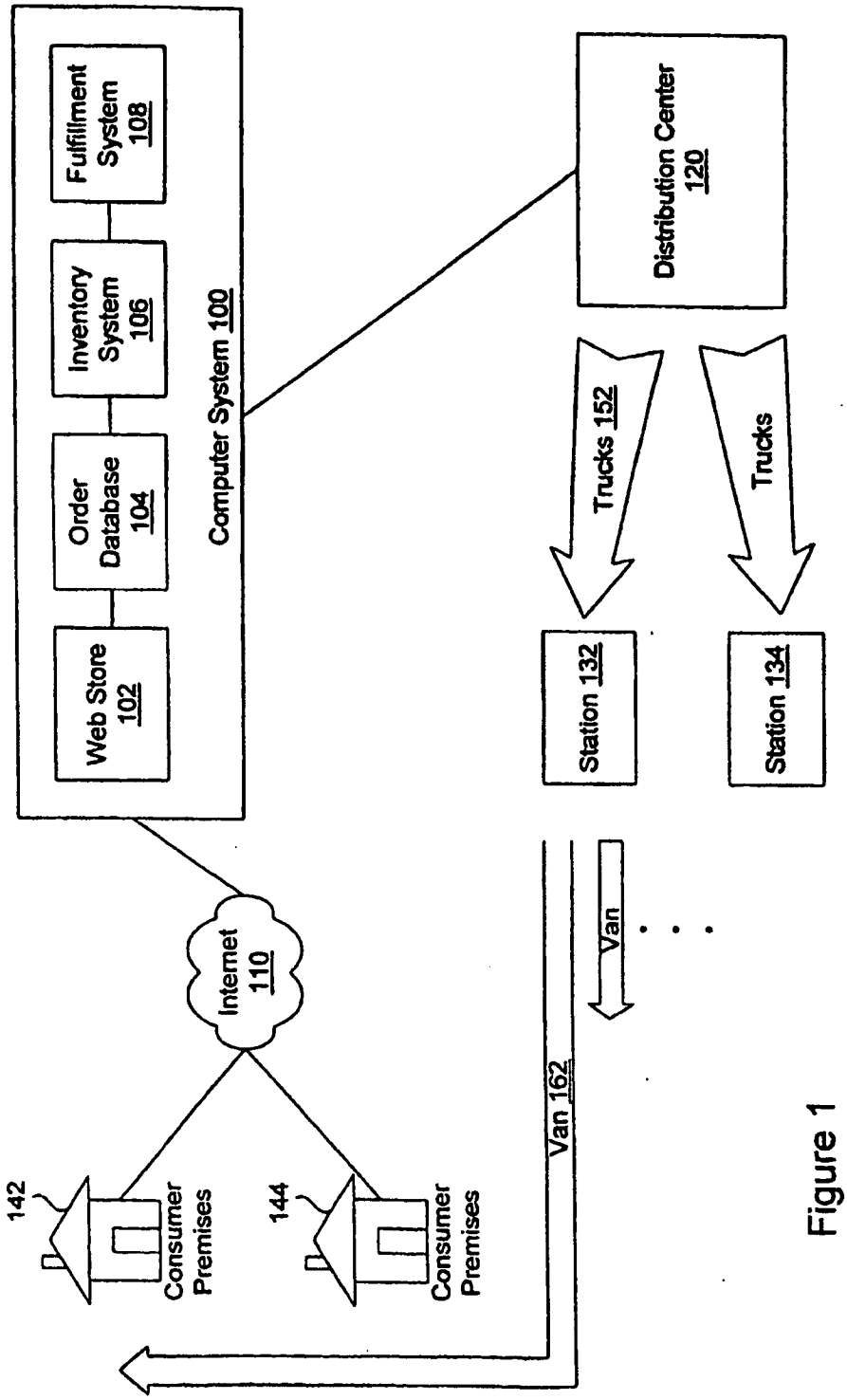
22. A method for planning the load of a truck, the load comprised of a plurality of containers, the method comprising:

selecting a number of routes from a plurality of routes, each of the plurality of routes corresponding to a route for a corresponding van;

identifying each of the plurality of containers destined for the number of routes;

using the automated distribution system to load the containers with contents corresponding to respective customer orders;

using the automated distribution system to transport the containers to a loading dock in a sorted order, the sorted order such that the containers on a particular dolly all go on a single route.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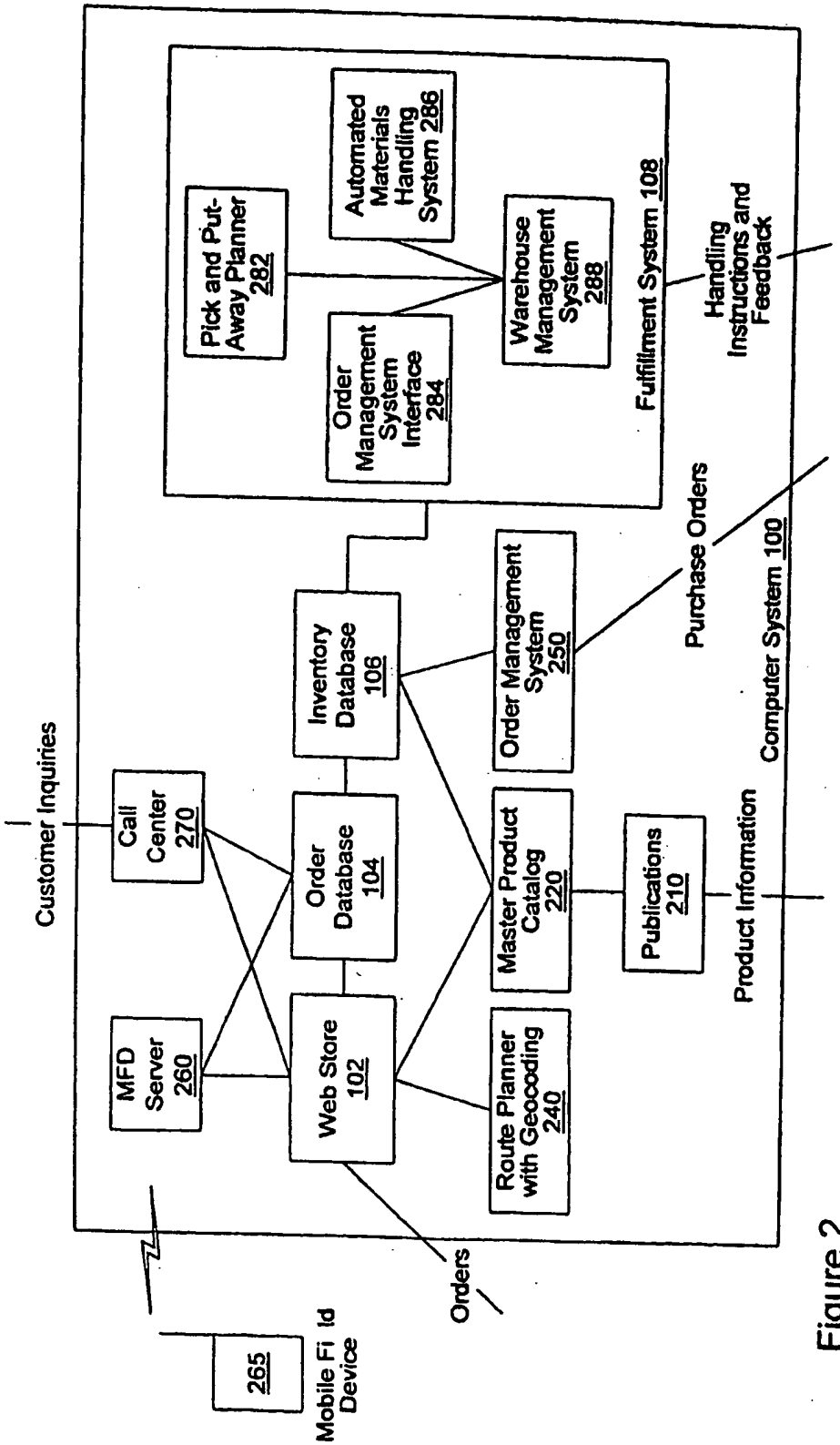
Web Store 102
Order Database 104
Inventory System 106
Fulfillment System 108
Distribution Center 120
Trucks 152
Trucks
Station 132
Station 134
Van
Van 162
Internet 110
142
Consumer Premises
144
Consumer Premises

Figure 1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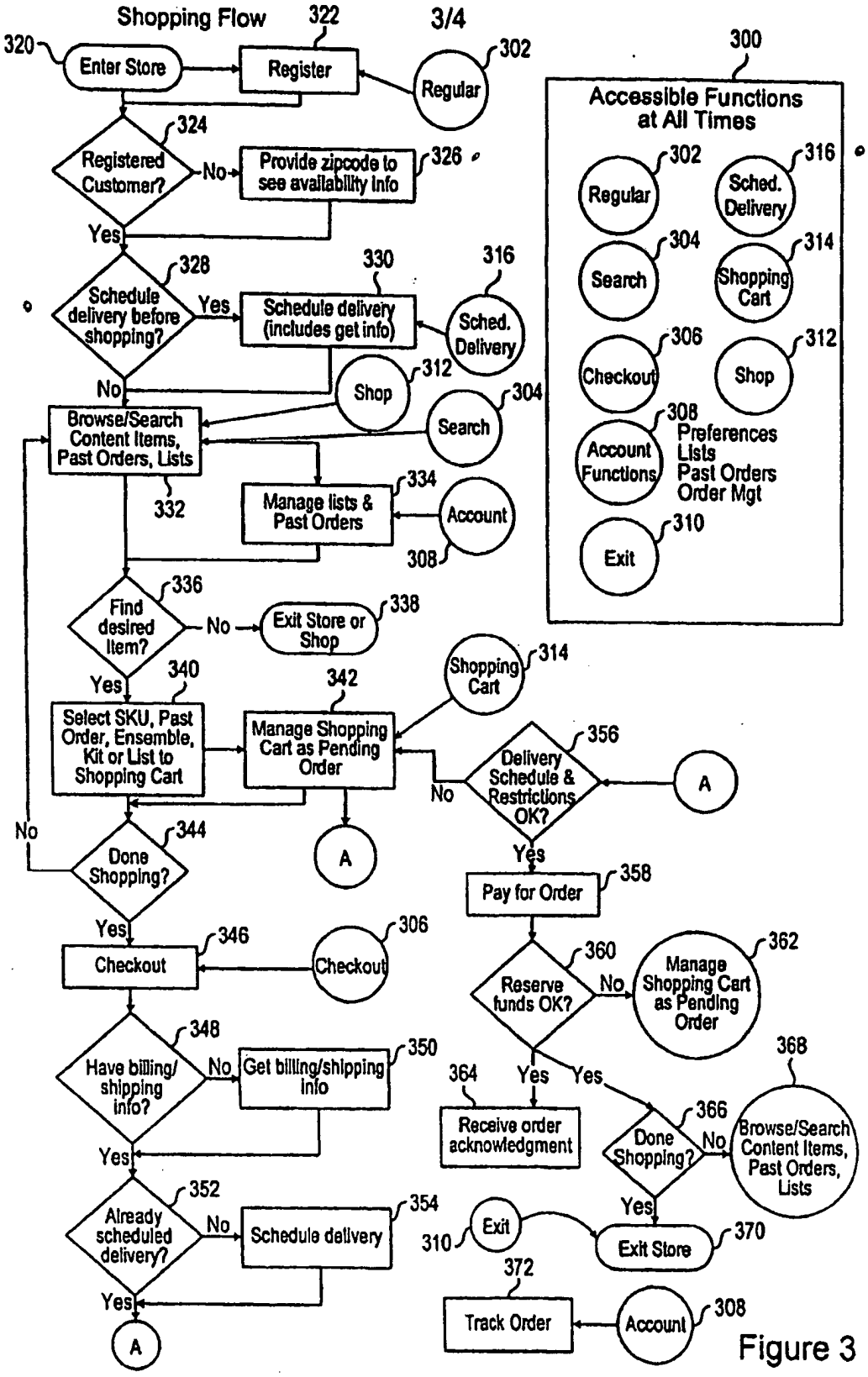
Call Center 270
MFD Server 260
Order Database 104
Web Store 102
Inventory Database 106
Route Planner with Geocoding 240
Master Product Catalog 220
Order Management System 250
Publications 210
Pick and Put-Away Planner 282
Automated Materials Handling System 286
Order Management System Interface 284
Warehouse Management System 288
Fulfillment System 108
Handling Instructions and Feedback
Purchase Orders
Computer System 100
Product Information
Orders
265
Mobile Fi ld Device

Figure 2


Shopping Flow
322
320
Enter Store
Register
Regular
302
300
Accessible Functions at All Times
Regular
302
Sched. Delivery
316
Search
304
Shopping Cart
314
Checkout
306
Shop
312
Account Functions
308
Preferences
Lists
Past Orders
Order Mgt
Exit
310
324
Registered Customer?
No
Provide zipcode to see availability info
326
Yes
328
Schedule delivery before shopping?
Yes
330
Schedule delivery (includes get info)
316
Sched. Delivery
No
Shop
312
Search
304
Browse/Search Content Items, Past Orders, Lists
332
Manage lists & Past Orders
334
Account
308
336
Find desired Item?
No
Exit Store or Shop
338
Yes
340
Select SKU, Past Order, Ensemble, Kit or List to Shopping Cart
342
Manage Shopping Cart as Pending Order
Shopping Cart
314
356
Delivery Schedule & Restrictions OK?
No
A
No
344
Done Shopping?
A
Yes
Pay for Order
358
Yes
346
Checkout
306
Checkout
360
Reserve funds OK?
No
Manage Shopping Cart as Pending Order
362
348
Have billing/ shipping info?
No
Get billing/shipping info
350
364
Yes
Yes
368
Receive order acknowledgment
366
Done Shopping?
No
Browse/Search Content Items, Past Orders, Lists
Yes
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Already scheduled delivery?
No
Schedule delivery
354
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Exit
Exit Store
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Yes
372
Track Order
Account
308
A

Figure 3

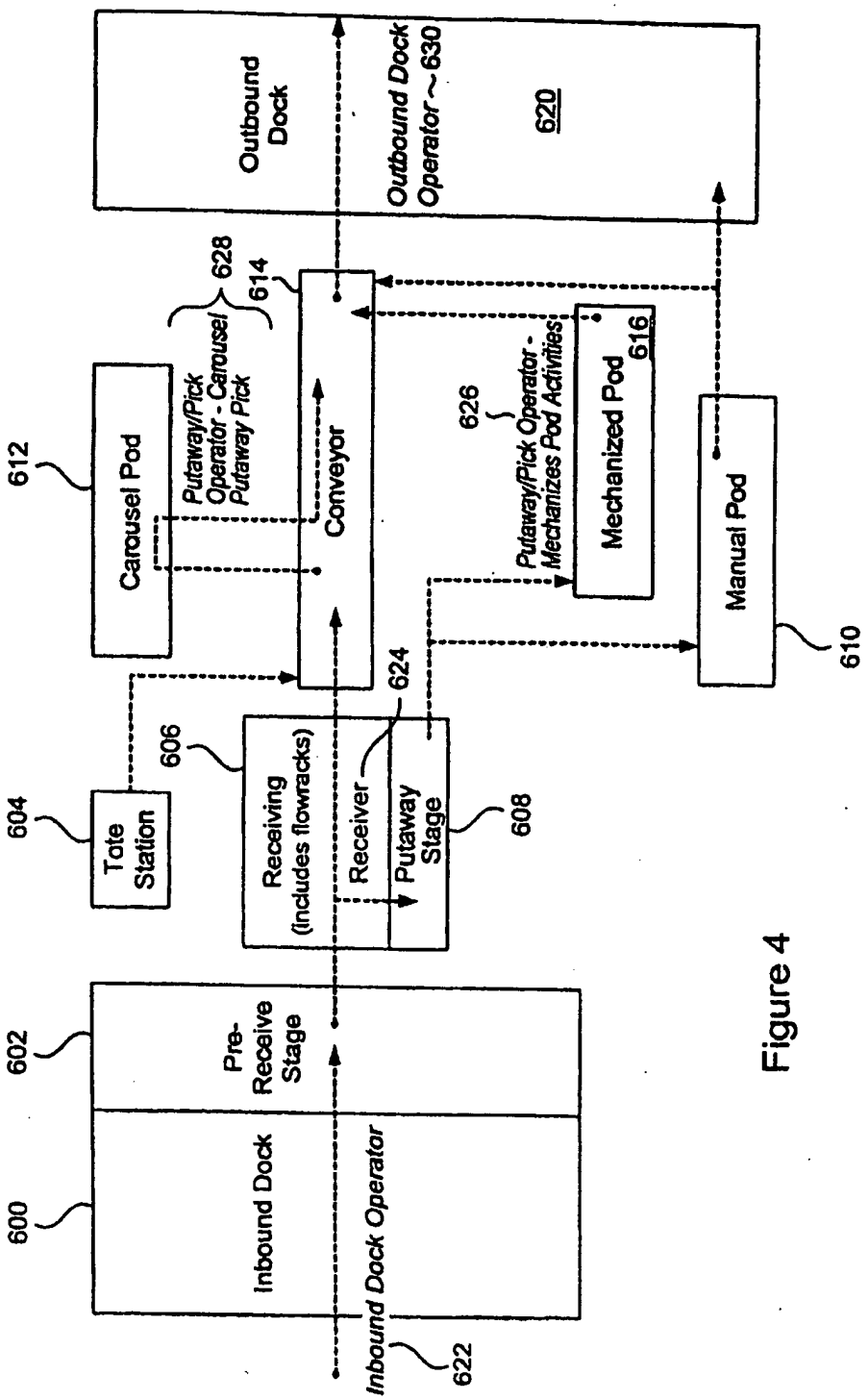
Outbound Dock
Outbound Dock Operator ~630
620
628
614
Putaway/Pick Operator - Carousel Putaway Pick
612
Carousel Pod
Conveyor
626
Putaway/Pick Operator - Mechanizes Pod Activities
Mechanized Pod
616
Manual Pod
610
624
606
604
Tote Station
Receiving (includes flowracks)
Receiver
Putaway Stage
608
602
Pre-Receive Stage
600
Inbound Dock
Inbound Dock Operator
622

Figure 4